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ERRATA.

Page	12, fig.	7, for	<i>baxtoni</i>	read	<i>buxtoni</i>
„	13, line	3, „	Kantora	„	Kantara.
„	16, „	4, „	E. d'Emmerez	„	<i>D. d'Emmerez.</i>
„	36, „	44, „	<i>calacitrans</i>	„	<i>calcitrans</i>
„	44, „	5, „	<i>Haplogonotopus</i>	„	<i>Haplogonatopus.</i>
„	87, fig.	11, „	<i>quirti</i>	„	<i>quiarti.</i>
„	103, line	5, „	Vol. iii.	„	Vol. vii.
„	104, „	18, „	<i>Pseudococcus</i>	„	<i>Pseudococcus.</i>
„	105, lines	13 & 19, for	<i>Pseudococcus</i>	sacchari, Newst.,	
				read	<i>Pseudococcus sacchari</i> , Ckll.
„	108, line	32, for	<i>Coccus</i>	„	<i>Cocos.</i>
„	118, „	35, „	<i>C.</i>	„	<i>P.</i>
„	126, „	1, „	<i>aegyptiacum</i>	„	<i>aegyptiaca.</i>
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„	„	38, „	<i>pseudaonidia</i>	„	<i>Pseudaonidia.</i>
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„	187, „	13, „	<i>sulphurea</i>	„	<i>sulfurea.</i>
„	210, „	4, „	<i>inflexus</i>	„	<i>inflexus.</i>
„	212, „	18, „	<i>visted</i>	„	<i>visited.</i>
„	221, „	37, „	<i>Out</i>	„	<i>with.</i>
„	236, „	5, „	van	„	von.
„	243, „	21, „	dipterologist	„	hymenopterologist.
„	256, „	25, „	<i>rupelli</i>	„	<i>rüppelli.</i>
„	267, „	15, „	Roder, H.	„	Röder, H. von.
„	238, line 7 ; 244, line 36 ; 248, line 30 ; 249, line 20, and 250, line 7,				
			for "Zahrb,"	read	"Jahrb."

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OBSERVATIONS ON SCALE-INSECTS (COCCIDAE)—IV.

By ROBERT NEWSTEAD, F.R.S.,

The School of Tropical Medicine, the University, Liverpool.

Llaveia abrahami, sp. nov.

Female, adult. Ovate, strongly gibbose above and flattened beneath; segmentation both on the dorsum and venter distinct. Colour, in alcohol, buff-yellow; with a thin deposit of white secretion in the hollows between the segments; legs and antennae yellowish brown. It is highly probable that much of the secretion had disappeared in the alcohol in which the specimens were preserved. Antennae of eleven segments, 2nd and 11th longest; 3rd a little shorter than the latter, but much longer than the succeeding ones, which are submoniliform in shape; average length 0.8–0.9 mm. Legs relatively short; tarsi a little more than half the length of the tibiae; front pair shortest, measuring 0.85 mm.; posterior pair longer, measuring 1.1–1.1 mm.; hairs relatively long and slender; claws simple, though in one example two of these organs have a well-marked tooth-like projection *dorsally*, just above the curved tip. Derm both dorsally and ventrally rather thickly set with very short fine hairs; margin with a narrow band of long fine hairs, the longest of which measure 0.6–0.7 mm. Pores dorso-ventrally relatively very small, circular and with beaded rims; these are less numerous than the fine hairs; those at the margins are slightly larger, much more numerous, and many have clear triangular-shaped centres. Anal segment of abdomen with three large ovate rings, the central one being slightly the largest and measuring about 0.2 mm. in its longest axis. Length, after maceration in KOH, 8.9 mm.

Larva. Very like those of the genus *Icerya*. Marginal hairs of great length, those in the abdominal region measuring 0.7–0.8 mm. There are four pairs of very long caudal hairs, the median pair slightly the longest, measuring 1.1–1.2 mm. Antennae of six segments; terminal segment with many hairs, of which six to seven are much the longest, the longest measuring 0.5 mm. Derm rather thickly set with long fine hairs and numerous pores similar to those in the adult but relatively larger. Legs

hairy ; digitules long and slightly dilated, upper pairs wanting ; claws slender, with a distinct ventral tooth near the tip. Eyes prominent and somewhat hemispherical. Length, 0.9–1 mm.

BRITISH GUIANA : Issororo, N.W. District ; “ inhabiting indentations in the bark of a rubber-producing tree (*Sapium jenmani*) ; attended by ants which construct coverings over the Coccids,” 3.vi.15 (*A. A. Abraham*, per G. E. Bodkin).

Differs from *L. primitiva* (Townsend) in its larger size, the number of antennal segments, and the absence of spines on the legs.

***Llaveia primitiva* var. *pimentae*, nov.**

Female, old adult. Dried example (1 only) elongate-ovate, highly convex dorsally, hollow ventrally, the latter character almost as marked as in certain species of the genus *Lecanium* ; segmentation of the abdominal region fairly distinct above ; the cephalo-thoracic region with a faint median keel, not extending to the front margin. The whole of the body clothed with a dusky white, farinaceous secretion, which is denser in the hollows of the abdominal segments, the irregular depressions of the thoracic area, and the hollow ventral surface ; the last-named also containing a small quantity of pure white flocculent matter, in which were found two dead larvae. Antennae of nine segments ; formula : 9, 1 (or 1, 9), 3, 2 (or 2, 3) (4, 5) (6, 7, 8), all the segments longer than wide ; length twice that of the anterior femur plus trochanter, or slightly more. Legs (anterior pair) relatively short ; femora incrassate, equal in length to the upper portion of the tibiae, the latter nearly one and a half times the length of the tarsi and furnished ventrally with nine to ten long slender bristles ; claws smooth on the under surface. Integument dorso-ventrally rather densely clothed with long stout bristles, and almost as thickly beset with circular “ rosette ” pores ; marginal hairs much longer and denser than those seen elsewhere, more especially so are they on the abdominal segments. Venter, near the distal extremity, with three large oval rings. Length (after maceration in KOH), 5.5 mm.

Female, young adult. Similar to the preceding, but with the marginal hairs very long, the longest of them equalling the length of the antennae. The only example has the antennae asymmetrical : one of ten segments with a partial division of the 4th, the other of seven segments only.

Female, second stage. Shape similar to that of the old adult, but less than half the size. Dorsum with or without a median ridge ; completely covered with a dense, pale yellowish-white secretion ; segmentation faintly indicated. Antennae variable, and in two examples asymmetrical, of eight or nine segments. Integument much more densely hairy than in the adult ; marginal hairs as in the young adult female. Length, 2.8–3.2 mm.

Larva (fully developed). Short ovate. Marginal hairs long and continuous in front ; the longest of those on the cephalic margin longer than the antennae. Caudal hairs in four pairs, of which the median pair is the shortest and less robust than the others, the longest hairs three-fourths the length of the body. Antennae with seven long hairs, the longest of which is nearly equal in length to the antennae. In the embryo larvae, taken from the body of the parent, the integument appears more

densely hairy than in the fully developed larva, owing apparently to the somewhat contracted nature of the integument. This applies also to the pores in the two stages respectively.

JAMAICA: on Pimento (*Pimenta officinalis*, Lindl.), 1916; "attended by the so-called 'stinking-ant,' *Cremastogaster* sp., and to be found under the loose bark; not of great importance." (*A. H. Ritchie*).

This may possibly prove to be Townsend's *Llaveia primitiva*, the slight differences being possibly due to the age of the individuals. Probably the normal number of antennal segments will prove to be ten. More material is needed.

***Monophlebus* ? *hirtus*, Brain.**

Brain* in his brief description of *Monophlebus hirtus* states that "the dermis is closely crowded with slightly clubbed glandular hairs and occasional long hairs, the latter fitting into thickened sockets," these characters being the salient features of the species. In the only specimen I have before me, the derm, more especially at the margin, is crowded with stout, blunt, curved spines (fig. 1, *b*), which, though

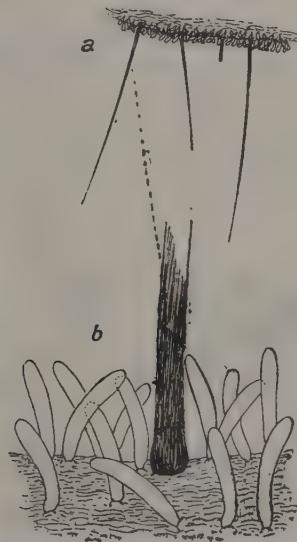


Fig 1. *Monophlebus* ? *hirtus*, Brain, ♀;
a, marginal spines and hairs.

slightly narrowed proximally, can scarcely be said to be club-shaped. Before my example was passed through the various reagents and mounted in Canada balsam, the margin was seen to be broadly set with long and very stiff hairs (fig. 1, *a*); but these were so easily deciduous and brittle that the majority of them broke away in the preparation. Length, 7.2 mm.

NYASALAND: Mt. Mlanje, 1913 (*S. A. Neave*).

* Trans. R. Soc. S. Africa, v, p. 165 (1915).

***Aspidoproctus neavei*, sp. nov.**

Female, adult. Ovate, sides elevated and more or less concave; dorsum in front relatively low; abdominal region highly convex. Cephalic or frontal depression well marked. Marginal dentate appendages long, rectangular, widely separated and ivory-like in colour and texture; there are about 25 of these altogether. Submarginal series of processes on the *anterior half of the body* (four to five in number) not quite so long as the marginal ones, but more robust and often irregularly dentate; the abdominal series, in continuation, diminishing in size distally. In the median line in front is a pair of small processes and behind them two to three *large single* ones. Midway between the median and submarginal processes are three very deep pits or depressions. Cavities and hollows coated with creamy white, granular secretion. Colour pale to dark castaneous; dull orange-crimson in alcohol; lower



Fig. 2. *Aspidoproctus neavei*, Newst., sp. n., ♀;
a, spines of gland tracts; *b*, marginal spines of
 lip of marsupial opening; *c*, pores; *d*, pores
 at angle of marsupial opening.

surface paler. Secretionary operculum relatively small compared with the size of the insect; it is normal in shape and of a dark brown colour. Antennae of ten segments; 3rd to 7th inclusive broader than long; 9th and 10th much the narrowest, being about half the width of the 6th, the 10th equal in length to the 6th, 7th and 8th, inclusive; 2nd nearly twice the length of the 4th; formula: 10, 1, 2, 3, 9 (6, 7, 8), (4, 5); two kinds of hairs present, subspinose forms and simpler slender ones; the longest of the latter equal in length to the terminal segment, and measuring 1.75 mm. Spines of the gland-tracts (fig. 2, *a*) incrassated proximally, apex bluntly pointed or sometimes slightly dilated; those of the proximal lip of the marsupial opening (fig. 2, *b*) generally curved and more or less spathuliform; elsewhere, both dorsally and ventrally, the spines are simple and more or less acutely pointed. Glandular

pores (fig. 2, c) circular; some apparently with compound openings others with a triangular, quadrangular or circular openings. Length, 15.5–21 mm.; width, 12–15 mm.; height, 6–9 mm.

Female, second stage. Ovate, sometimes slightly narrowed anteriorly; posterior half of margin rather broadly produced or flattened; dorsum convex. Marginal dentate processes similar to those in the adult but smaller. Dorsum without dentate processes and, with the exception of the rubbed portions, covered with granular secretion. Dorsal glandular pores circular, with four openings. Glandular pores at the angles of the marsupial opening (fig. 2, d) of three types; a relatively small form of somewhat variable shape, a large form with six openings, and a roughly quadrate form with four openings. These glandular orifices in the old adults become more or less obscure owing to the density of the chitin.

NYASALAND: Mt. Mlanje, on "Mwange" tree, x. 1913 (*S. A. Neave*).

This Coccid differs from *A. pertinax*, Newst., in being less convex (especially in the abdominal region), and in the larger size and arrangement of the dorsal thoracic processes.

***Aspidoproctus verrucosus*, sp. nov.**

Female, adult. Subhemispherical, produced in front, flat beneath; secretory operculum complete. Integument blackish; sparsely clothed with dusky golden pubescence, and punctate between the patches of secretion. Margin with short, tooth-like, contiguous appendages, dusky white in colour, with here and there faint traces of yellow, tips more or less pure white. Frons with two converging rows of similar, but smaller and confluent, processes. Above the last-named in the middle line are three widely separated, transverse rows of very small tooth-like appendages surrounded by dusky granular secretion. Leading from the third group towards the anal margin is a narrowly ovate series of scurfy patches and surrounding them an almost complete circle of similar patches of secretion. Between the various tooth-like processes are other irregular patches of secretion, which collectively give the insect a decidedly warty or more or less mottled appearance. Derm rather densely clothed with relatively long spines, some of which are truncated, possibly owing to injury. The special gland-tracts at the margin of the abdominal area surrounded by a dense wall of spines taking a quadrangular or rectangular form; within these are one or two small groups of circular glands. There are at least three other types of glands on the venter, including a large quoit-shaped one of slightly varying dimensions, these being most conspicuous in the region of legs ii. and iii. Length, 8.5; width, 7.3; height, 5.5 mm.

UGANDA: Ngamba Is., on trunk of a fig tree, 16. v. 14 (*Dr. G. D. H. Carpenter*).

In its general shape this Coccid resembles a very small example of *Aspidoproctus pertinax*, Newst.; but it is otherwise markedly distinct. The mouth-parts and antennae were absent in all the specimens, and were evidently detached when removing the insects from the tree.

***Palaeococcus bicolor*, sp. nov.**

Female, adult. Ovate, narrowed in front, covered with short bright yellow or white waxen processes, which are arranged in seven more or less well-defined rows:

one short, median, and three on each side, the lateral rows continuous behind; intervening spaces with somewhat granular wax; margins with outstanding hairs, which appear more numerous and much longer posteriorly. Venter, in the oldest examples, with a relatively thin layer of white wax, but this, in the specimens submitted, does not form a distinct ovisac or pad. Antennae of nine to ten segments; in two instances they were asymmetrical; terminal segment not quite so long as the two preceding ones together; there is a long slender spine on the second, and long stout hairs on the succeeding ones, in addition to which there are two to three very long slender hairs on the terminal segment, one of which is equal in length to the last two segments together. Legs very robust and long. Derm markedly hirsute; spinnerets large, circular and almost as numerous as the hairs. Stigmata relatively small. Margins with immensely long stout hairs, the longest being three times the length of the antennae. Many of the marginal hairs are dilated and frayed distally and sometimes present three distinct, lateral ridges, resembling somewhat the proximal half of the scapula of a mammal in miniature; these are clearly malformations due, possibly, to injury by abrasion. Length, 5.5 mm.-6.5 mm.

Female, second stage. Waxed covering similar to that of the adult, but the median and submedian rows are not so pronounced; colour bright yellow, or rarely pure white. Antennae of seven segments, of which the third and seventh are the longest. Derm sparsely hirsute; pores much fewer than in the adult. Marginal hairs of immense length, the longest and stoutest arising from the abdominal segments; these are, when perfect, four times the length of the antennae, or slightly longer than the entire length of the insect. Length, 2-2.3 mm.

Larva. Antennae with the terminal segment markedly incrassate, with five immensely long, stout, lateral hairs; the largest about twice the length of the antenna. Derm thickly set with fine long hairs; margins with similar but slightly longer hairs; terminal segment of abdomen with three pairs of long hairs, of which the median pair is about half the length of the others; the two pairs of longest hairs three times the length of the antenna, or about one-fourth longer than the body.

GOLD COAST: Aburi, on *Thespesia* sp. (W. H. Patterson).

The general appearance and arrangement of the cereous coverings of the old adults resemble somewhat those of the young adult ♀ of *Icerya seychellarum*, Westw.; but the strongly hirsute character and great length of the marginal hairs may readily serve to distinguish it. That the colour of the waxy covering should vary between bright yellow and white is rather remarkable, but the former, so far as one can judge from the few examples at hand, is the predominant colour. There is no admixture of the two colours in the same individual; all are either entirely white or entirely bright yellow.

***Palaeococcus caudatus*, sp. nov.**

Female, adult. Apparently without any trace of an ovisac; dorsum covered with short stout waxen processes, white or dirty white in colour and thickly felted in texture; these processes are arranged in seven rows: the median row much the broadest and coalescing, more or less; the other rows almost uniform in size

and continuous in front, so that they appear concentric with the median row; the marginal row almost hidden by the submarginal row. A number of long hairs project beyond the waxen covering, especially at the margin in front. Posterior extremity markedly narrowed and with a single long stout waxen appendage or tail-like process. Integument, antennae and legs of dead examples pitchy-black. Antennae of eleven segments and of the usual form found in the females of this genus. Legs normal. Marginal hairs very long, the longest being a little more than one-third the total length of the body; these hairs are much more numerous in front and also posteriorly; at the sides of the body they are arranged in rather widely separated groups. Integument densely studded with relatively large circular spinnerets, interspersed with fine short hairs, the latter much more numerous ventrally. Length, inclusive of waxen appendages, 7-8 mm.; length, exclusive of caudal appendage, 5 mm.

Female, second stage. Dorsum with five rows of white waxen appendages; median row coalescing; submedian and marginal rows much shorter than in the adult female; caudal process similar to that in the adult. Antennae of nine segments; marginal hairs and spinnerets as in the adult, but the former are relatively longer, being about one-half the total length of the body.

UGANDA: Entebbe, on crotons, 13.viii.12 (*C. C. Gowdey*).

The somewhat pyriform outline of the female, with the long stout caudal appendage, should readily serve to distinguish this insect from any of its allies.

***Palaeococcus cajani*, sp. nov.**

Female, adult. Ovate and highly convex. Waxy covering pure white, the arrangement very like that of *Icerya euphorbiae*, Brain,* but more or less distinct processes are traceable; these are arranged as follows: margin with 13-14 short and bluntly rounded processes packed closely together and coalescing behind; immediately above them is a well defined constriction, and over this a ridge with similar but more irregular processes; cephalic extremity with an irregular cluster of blunt processes; the rest of the dorsum denuded by pressure in packing. Colour of integument black. A number of fine hairs protrude through the waxen covering. No ovisac, but a little flocculent secretion beneath the body. Length of dried example, 3.9 mm.

When first placed in chloroform the marginal appendages show up very distinctly and the outstanding hairs are regularly arranged so that a pair of them (one dorsal, the other ventral) form the dividing line between the waxen processes. Colour in this medium, dull orange-crimson. Antennae (fig. 3, *a*) of nine segments; the terminal equal in length to the second and third together; all, with the exception of the last two, broader than long; hairs of two kinds: a relatively short form, which is somewhat spinose, and a very long slender one; the longest on the last three segments, one of which is twice the length of the distal segment. The antenna on the opposite side has the articulations of the third and fourth segments very faintly indicated. Legs with the femora very broad; tibiae and tarsi with slender hairs of varying lengths. Derm scantily clothed with hairs; pores (fig. 3, *b*)

* Trans. R. Soc. S. Africa, V, p. 167, pl. xxii, fig. 48.

circular, presenting the characteristics shown in the illustrations according to the plane in which they are focussed. Marginal hairs very long; one of the longest, just behind the antennae, about one-fourth longer than the latter, or about half

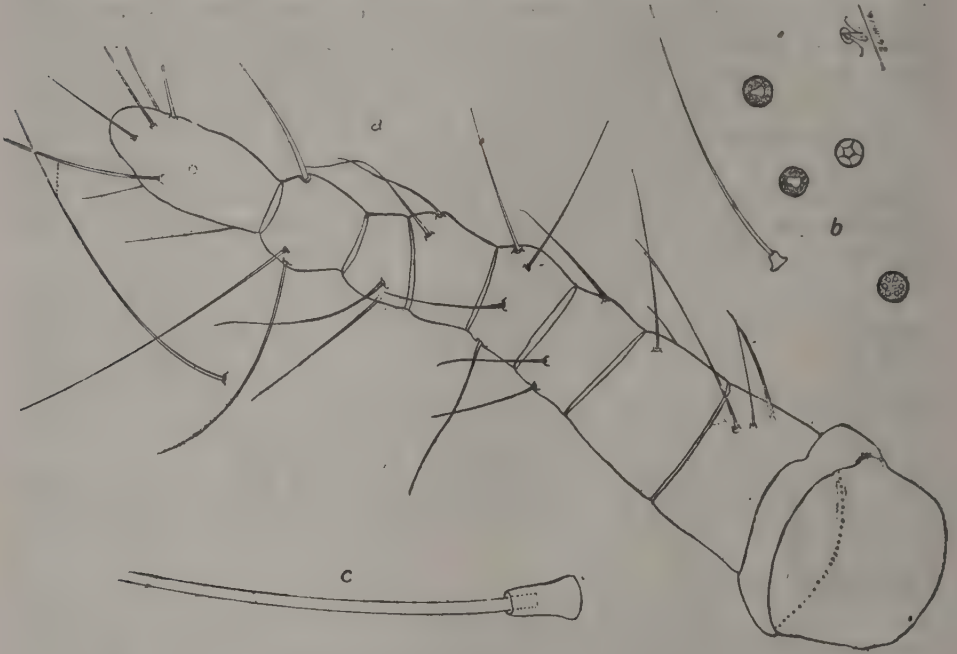


Fig. 3. *Palaeococcus cajani*, Newst., sp. n., ♀; a, antenna; b, gland pores; c, base of dermal hair.

the width of the body; these structures are readily deciduous and very few are left intact in mounted material.

S. NIGERIA: Agege, on pigeon pea, 1914 (Dr. W. A. Lamborn).

***Icerya nigroareolata*, sp. nov.**

Female, adult. Secretory covering and appendages very like those of *Icerya aegyptiaca*, Douglas, but the flocculent matter beneath the appendages is thicker. When macerated in KOH the females assume a very elongate form, thus differing materially from *I. aegyptiaca*, which is *broadly ovate*. Antennae of eleven segments; fourth the shortest and broader than long; eleventh longest and twice the length of the tenth; hairs very long and for the most part arranged in whorls, the longest hairs (terminals) being slightly longer than the two last segments together; formula 11 (2, 3) (7, 8, 9, 10), 1, 4, or 11 (2, 3, 7, 8, 9, 10), 1, 4. Legs robust; hairs on the upper surface of the tibiae very long, the longest being equal in length to the tarsi (fig. 4, a); digitules simple. Marginal hairs relatively short, the longest arising from between the antennae and also at the anal extremity; some of the former about half the length of the antennae. Derm rather sparsely hirsute. Pores or spinnerets (fig. 4, b) of two types: one large, with an inner hexagonal

border; the other less than half the diameter of the former, with a beaded margin; the large ones are generally distributed over the dorsum and also form large triangular groups along the margin of the abdomen. Venter with three large vaginal discs or areoles, the laterals (fig. 4, c) reniform, the median one ovate, with a faint central transverse division or construction; these, if maceration is not carried too far, are seen to be completely covered with opaque black pigment; when the pigment is partly removed a finely reticulated surface is visible, but when completely removed the reticulation may disappear almost completely. Length of macerated specimens, 5-6 mm.; width, 2.50-3 mm.

Larva. Very elongate. Gland pores or spinnerets as in the adult; arranged in regular transverse rows, the larger ones preponderating, the smaller ones confined chiefly to the median line. Terminal segment of the antennae with three long hairs, the longest being one-fourth longer than the antennae; the remaining hairs are also very long, but less than half the length of the longest. Marginal

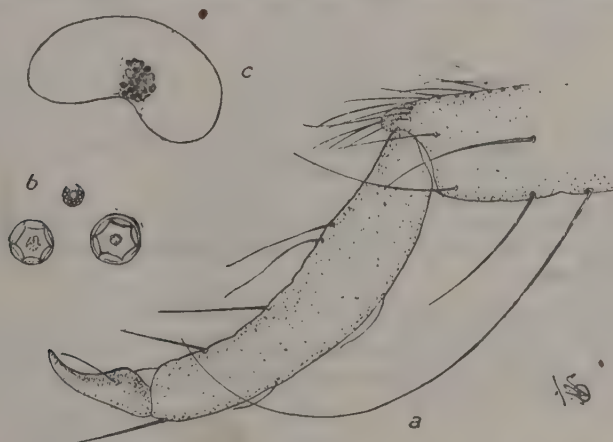


Fig. 4. *Icerya nigroareolata*, Newst., sp. n., ♀; a, tarsus; b, gland pores; c, lateral areole, with portion of pigmented surface.

hairs very long, the longest of the abdominal ones nearly as long as the antennae; the long caudal hairs six in number, three on either side of the anal orifice; two are very long, being almost as long as the body, the third a little more than half the length of the others. Length, 0.9-1 mm. Length of antennae, 0.4 mm.

UGANDA: Kampala, on coffee, 4.xi.13 (C. C. Gowdey); Jinja, on croton, 1914 (Dr. R. Van Someren).

***Icerya sulfurea* var. *pattersoni*, nov.**

Female, adult. Waxy covering bright pale yellow; covering of the dorsum imperfect, but that which remains is suggestive of short stout plates; marginal series of waxen appendages long, broad, curved downwards and slightly curled distally. Ovisac well defined; colour, white or white with a faint tinge of yellow. Derm faintly hirsute, but thickly studded with minute hairs interspersed with long slender ones. Margins with irregular groups of long outstanding hairs, the

longest varying between one-third and one-half the length of the antenna. Pores circular and very numerous; these are of two sizes: the larger (fig. 5, *a*) being twice the diameter of the others. Antennae (fig. 5, *b*) of eleven segments; terminal segment much the longest but scarcely wider than the preceding one.

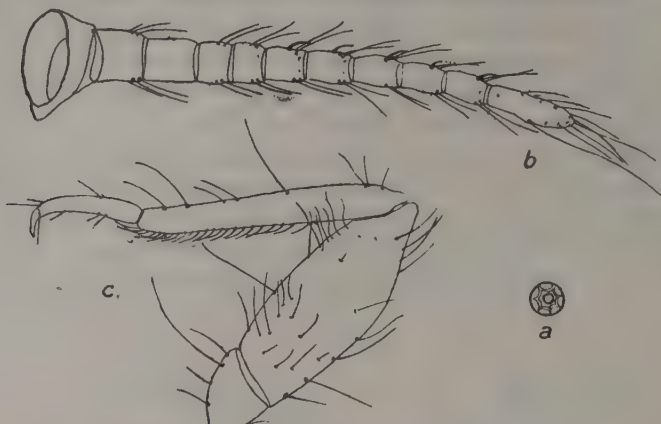


Fig. 5. *Icerya sulfurea* var. *pattersoni*, Newst., nov., ♀;
a, pore; *b*, antenna; *c*, leg

Legs (fig. 5, *c*) long; femur very short; claw faintly bidentate, digitules simple hairs; underside of tibia very hairy. Eyes truncate. Stigmata large, slightly longer than the tarsus.

GOLD COAST: Aburi, on *Tectona* sp. (W. H. Patterson).

The form and arrangement of the waxen appendages are very like those in *Icerya aegyptiaca*, Doug., but the bright pale yellow colour is distinctive and the structural details differ.

***Margarodes buxtoni*, sp. nov.**

Female, adult. Form rather elongated and very tumid. Derm almost completely covered with a layer of white, mealy secretion. Colour in alcohol, dull brownish-crimson. After maceration in KOH the body assumes a broadly ovate form (fig. 6, *a*). Derm, on both surfaces, finely but markedly pubescent, the individual hairs relatively long and exceedingly slender. Pores (fig. 6, *f*) circular, with a central opening and numerous minute ones surrounding it; these organs are almost as numerous as the hairs, more especially so on the terminal segments of the abdomen. Antennae (fig. 6, *b*) short, stout, and widest proximally, composed of eight segments, each (with the exception of the last) with a well-defined chitinous band; distal segment with several minute stout spines, and two groups of long fine slender hairs; the remaining segments are apparently nude, but of this one cannot be quite certain, as the innumerable hairs on the surrounding integument are lying superimposed over a great portion of the antennal segments. Anterior leg (fig. 6, *c*) large, stout, and more than twice the size of the other limbs; claw densely chitinated and distinctly articulated with the exceedingly short tarsal segment; tibio-tarsal articulation well defined, and immediately below this is a

distinct group or tuft of long fine hairs. Posterior legs (fig. 6, *d*) not differing materially from the intermediate pair; claws distinctly articulated; digitules represented by slender hairs. Eyes well developed, truncate, and placed considerably below the antennae (see fig. 6, *a*). Thoracic stigmata (fig. 6, *e*) large and somewhat reniform in outline; outer lateral lobe-like extension with a group of circular pores; abdominal stigmata present on the first and second segments only; these organs are represented by minute circular orifices, external to which is a roughly horse-shoe-shaped thickening of the body wall. Anal orifice circular;

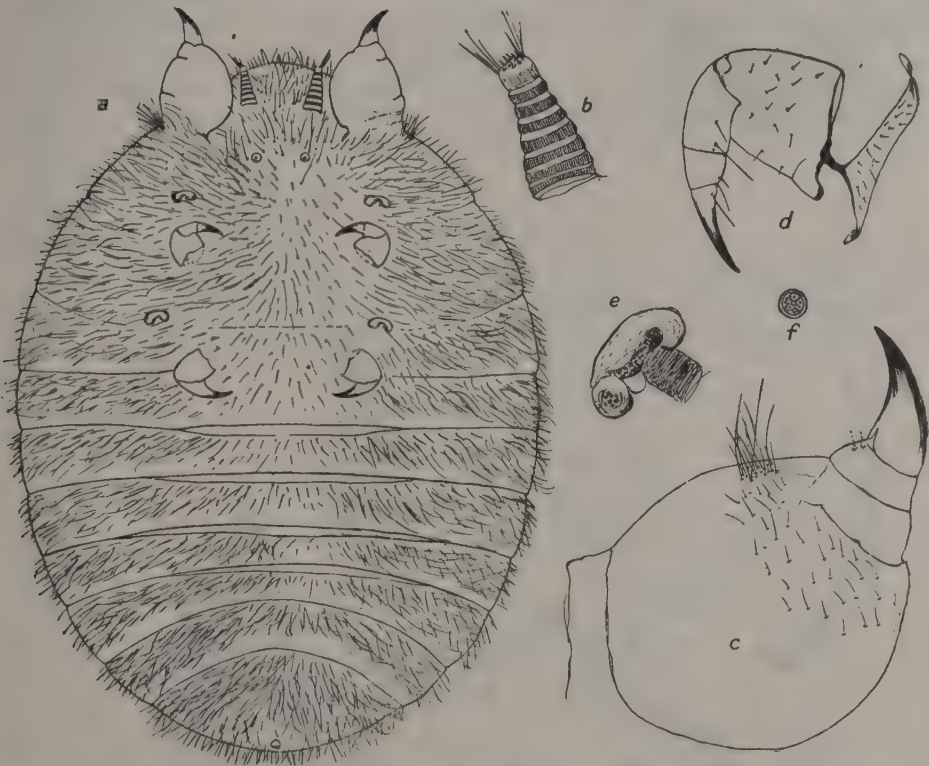


Fig. 6. *Margarodes burtoni*, Newst., sp. n., ♀; *a*, ventral view of a specimen cleared in potash; *b*, antenna; *c*, front leg; *d*, posterior leg; *e*, stigma; *f*, pore.

ring strongly chitinated, with a disc-like structure at the distal margin. Vaginal orifice nearly opposite the anal opening. Length, 5.7 mm.; width, 4.3 mm.; length of front legs, 1 mm.

Male (fig. 7, *a*). Colour of dried specimens dark piceous; when placed in potash, rich dark crimson. Wings hyaline; costa pale crimson, darkening distally; veins, of which there are traces of three, faintly indicated; outline variable in the two examples before me; in one the wing is slightly longer and narrower than the other. Subterminal segment of the abdomen with a dense tuft or pencil of fine white silky filaments. Antennae (fig. 7, *b*) of nine segments, and finely pubescent; distal segment

much the longest, and furnished near the tip with a minute circular sensorium; articulations of the last four segments with relatively broad and clear integument. Eyes large, compound; a single prominent ocellus on the proximal edge of each of the compound eyes. Sculpturing of thorax doubtful, but apparently with prominent rounded gibbosities. Anterior legs (fig. 7, *d*) much shorter and more markedly robust

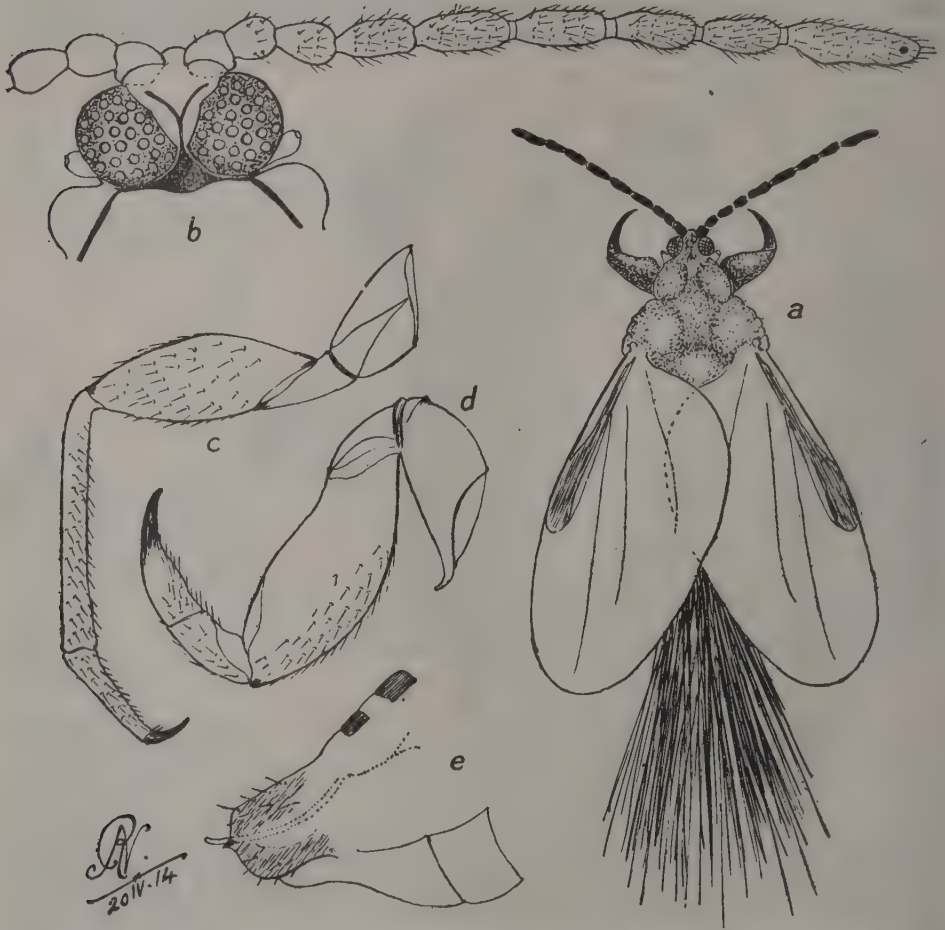


Fig. 7. *Margarodes baxtoni*, Newst., sp. n., ♂; *a*, dorsal view, from a dried specimen; *b*, head and antenna; *c*, hind leg; *d*, front leg; *e*, pygidium, lateral view.

than the others; tarsus and claw united, the latter strong, stout and densely chitinated; femur, tibia and tarsus with fine hairs. Posterior leg (fig. 7, *c*) well developed; the tibia a little more than twice the length of the tarsus; claw distinctly articulated; femur, tibia and tarsus clothed with fine hairs. Terminal segment (fig. 7, *e*) broad and somewhat quadrate, with a distinct median angular projection; intromittent organ slender and cylindrical. Owing to the density of the chitin the special groups of

glands from which the tuft of silky filaments arise are not traceable. Length, inclusive of the anal tuft of filaments, 4·5 mm. ; exclusive of the filaments, 2·5 mm.

ALGERIA: El Kantora, 13.iv.13, 1 ♀, 2 ♂♂ (*P. A. Buxton*).

Mr. E. E. Green, to whom I forwarded the above description and drawings, considers that "this *Margarodes* is undoubtedly a new species. In its hairy integument it approaches my *M. niger*, but that species has limbs of a very different form."

***Stictococcus gowdeyi*, Newst.**

SOUTHERN NIGERIA: Agege; on young shoots of cacao, invariably protected by the ant *Oecophylla*, 1915 (*Dr. W. A. Lamborn*).

These examples differ from the type lot of specimens by being of a rich dark translucent crimson or of a translucent olivaceous yellow, sometimes with a trace of crimson. They are, in all probability, young adults which had not acquired the permanent colour of more mature examples.

***Stictococcus intermedius* sp. nov.**

Female, adult. General facies as in *L. sjöstedti*, Ckll. Pseudo-margin with a regular series of short, deep, sharply defined and slightly radial grooves, giving the extreme edge a finely crenulated appearance, as if marked by a roulette; midway between

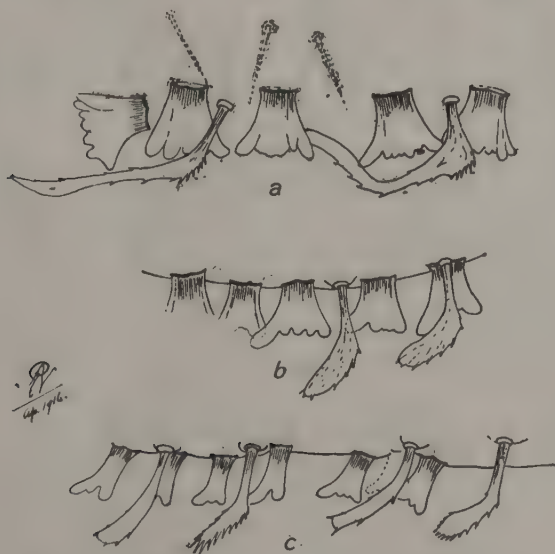


Fig. 8. *Stictococcus intermedius*, Newst., sp. n.; marginal spines of: a, adult ♀; b, second stage ♀; c, larva at period of ecdysis.

the median line and the roulette border is an irregular row of deep, clearly defined pits—seven to eight on either side. Colour pale to dark castaneous or piccous, with the integument polished. Marginal spines (fig. 8, a) of two distinct forms: (1) broad and irregularly digitate, and (2) very long, somewhat contorted, broad and

flat, geniculated, and finely spinose; just within the margin is a series of long, slender, simple spines. The young adults are reddish buff in colour, with the pits and hollows of the roulette border piceous or dark castaneous. Length, 3-4 mm.

Female, second stage. Short ovate, flat, with the sides slightly raised. Colour pale reddish-buff. Marginal spines (fig. 8, *b*) broadly digitate and similar to those in the adult, but usually with one of the lateral projections more pronounced than the rest; and a broad, flat, falciform and spinose one alternating more or less with the others.

Larva (at period of ecdysis) with the marginal spines as shown in fig. 8, *c*.

GOLD COAST: Aburi, on cacao, ? 1913 (*W. H. Patterson*).

Separable from *S. sjöstedti*, Oskl., by the form of the marginal spines (in all stages) and by the sculpturing of the dorsum in the adult female.

***Stictococcus multispinosus*, Newst.**

Male puparium. Like that of *Kermes quercus* (Linn.); a white, felted, elongated sac, and very brittle. Two examples were found wedged in between the old adult females. Neither was quite perfect; one contained a propupa, the other was empty.

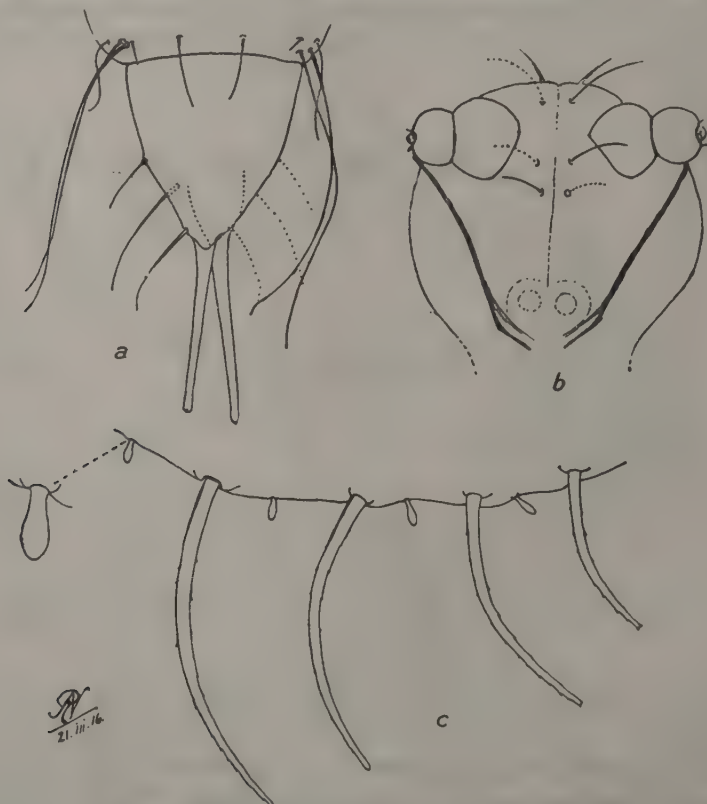


Fig. 9. *Stictococcus multispinosus*, Newst., sp. n.:
a, terminal segment of ♂; b, head of ♂; c, marginal
spines of larva.

Propupa. Turned to dull crimson in cold KOH. Very robust. Frons with one pair of bristles. Genital sheath short, obtuse. Abdominal segments with a few stiff hairs. Length, 0.8 mm.

S. NIGERIA : Agege, on pigeon-pea stems, 1914 (*Dr. W. A. Lamborn*).

Male (imperfect). Head slightly longer than broad; ventral surface (fig. 9, *b*) with two divergent narrow sclerites, and four pairs of bristles, which are separated by a median longitudinal suture, the distal pair on the frontal margin. One pair of ocelli near the apex formed by the sclerites. Thoracic apodeme normal. Legs long, sparsely clothed with bristles; claws rather strongly falcate; lower digitules with slightly longer knobs than those of the tarsi. Abdomen very elongate; the segments with submedian and lateral bristles, the terminal segment with a pair of very long marginal bristles. Genital armature (fig. 9, *a*) with three pairs of long bristles; stylus in two parts, with the tip of one bluntly rounded, the other truncate. Length, 1.3 mm.

Larva. Marginal spines (fig. 9, *c*) of two forms; minute club shaped ones, alternating with immensely long, stout, curved and barbed ones.

UGANDA : Kampala, on *Markhamia platycalyx*, 2.ix.15 (*C. C. Gowdey*).

***Asterolecanium spectabile* sp. nov.**

Femal. puparium. Lanceolate and convex dorso-ventrally; margins broadly flattened, with slight constrictions opposite the stigmata; slightly narrowed and produced posteriorly. Surface strongly punctate; a definite narrow median suture extending nearly the whole length of the puparium, the suture faintly interrupted at regular intervals along the abdominal region, suggesting segmentation. Colour brilliant orange-crimson, with black suffused markings anteriorly, the latter due to the under-lying shrivelled body of the female; the narrowed posterior end opaque, glassy and colourless; the cephalic margin narrowly orange-crimson. Fringe composed of closely adjacent, straight, glossy filaments of a pinkish colour; in very young individuals this lies flat upon the surface of the leaf, but as the ventral portion of the test gets more and more convex (exteriorly), the fringe drops and becomes vertical; as a rule, it is either entirely wanting or can be traced only in isolated and abraded patches. Length, 1.3-2 mm.

Female, adult. Form somewhat doubtful, but clearly very elongate and probably filling the test at gestation. Rostrum approximately central. Paired or 8-shaped pores disposed in a single row, not extending to the posterior extremity or the extreme cephalic margin. A short series of small circular glands on the ventral margin opposite the thoracic stigmata only. Tubular glands geniculated, with the proximal end attenuated; these are distributed over the whole of the dorsal area; their length equal to the greatest diameter of the rudimentary antennae, approximately. Abdominal extremity with two minute setiferous lobes; setae short and with their tips broken away in all the preparations (eleven). Anal ring hairless, its diameter not much greater than the basal attachments of the setae of the lobes. Genital orifice relatively very large, transverse, and placed well away from the anal orifice. Rudimentary antennae with three to four extremely minute spines.

Male puparium. Similar to that of the female, but slightly narrower; the ends equally rounded. Colour as in female. Length, 1.5; width, 0.5.

The puparia of the young females (2nd stage) are amber-yellow in colour.

MAURITIUS; Botanic Gardens, on palm trees, 1915 (*J. d'Emmerez*).

A really handsome species and the only one known to me which has such brilliantly coloured puparia.

***Lecanodiaspis tarsalis*, sp. nov.**

Female test. Colour warm buff; narrowed slightly posteriorly; dorsum convex, with a median interrupted longitudinal ridge, and about twelve transverse ones on each side. Orifice terminal, circular; projecting from it, in some individuals, is a short white waxy filament. Texture dense; surface with exceedingly minute whitish particles. Length, 2-2.2 mm.; width, 1.2-1.3 mm.

Female, adult. Legs (fig. 10, *a, a*) well developed; anterior tarsi unusually long, with a deep and clearly defined dorsal constriction; tibiae relatively short, from

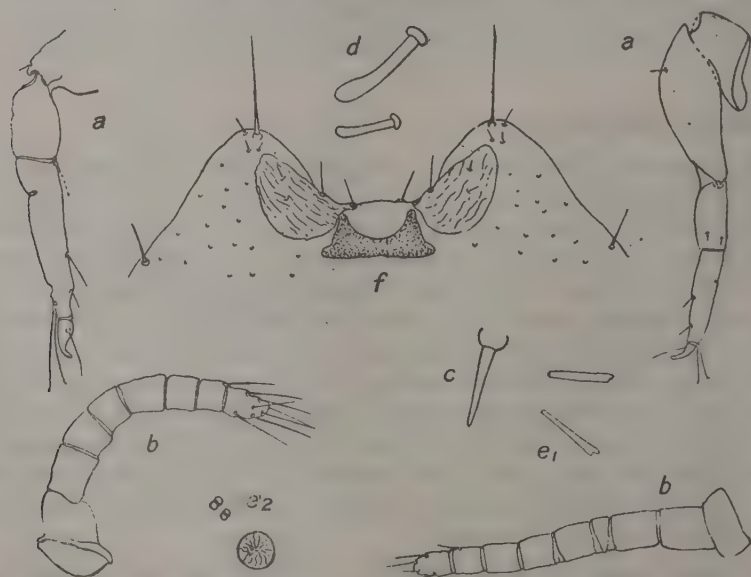


Fig. 10. *Lecanodiaspis tarsalis*, Newst., sp. n., ♀; *a, a*, legs; *b*, antennae; *c*, marginal spine; *d*, anterior stigmatic spine; *e1*, tubular glands; *e2*, cribriform and 8-shaped pores; *f*, anal segment.

one-half to one-third the length of the tarsi; digitules long, those of the tarsi very faintly knobbed. Antennae (fig. 10, *b*) normally curved, of nine segments; 8th with a short hair, 9th with several; relative length of individual segments varying slightly, 2nd and 3rd usually the longest, but sometimes the 6th is as long as the 3rd. Marginal spines (fig. 10, *c*) stout and rather bluntly pointed; these are widely separated. Anterior stigmatic spines (fig. 10, *d*) two, both spatuliform, one-half the length of the other; posterior pair both short and very widely separated. Tubular glands (fig. 10, *e1*) generally distributed over the whole of the derm. and so numerous as

sometimes to touch or slightly overlap each other; about two-thirds the length of the marginal spines; 8-shaped pores generally distributed but most numerous towards the margin. Two divergent rows of cribriform plates (fig. 10, e_2), four on each side of the median line; these are circular, with labyrinthiform gratings, the diameter about three times as great as the length of the 8-shaped glands. Anal segment (fig. 10, f) with rather prominent lobe-like extensions and a broad bilobed plate below the anal aperture, each with a pair of very short subapical spines and two long marginal hairs. Pre-anal plate with a very deep emargination. Anal ring with ten hairs.

Larva. Elongate. Antennae stout, of six segments; 3rd and 6th longest, but both relatively short. Marginal spines minute. Anterior stigmatic spines similar to those of the adult; posterior pair absent. Legs robust; anterior tarsi much longer than the tibiae. The 8-shaped pores in well-defined longitudinal rows. Anal lobes similar to those of the adult, but the terminal bristles are much longer. Anal ring with six hairs.

SOUTH AFRICA: Pretoria, 1914 (*E. d'Emmerez*).

This insect is related to *Lecaniodiaspis africana*, Newst.,* but is still more remarkable in having the legs normally developed. It differs moreover in its smaller size, the presence of marginal and stigmatic spines, the extraordinarily long tarsi, the antennal formulae, the character of the "cribriform plates," and in other details.

Phenacoccus ballardi sp. nov.

Female, adult. Dorsum, in dried example, covered with a felted mass of white secretion, completely obscuring the segmentation; margin with a conspicuous fringe of extremely long, white appendages, which are shortest in front; those arising from the cephalic margin about three times the length of the felted dorsal area. Length, inclusive of the fringe, 10 mm.

Form, after maceration in potash, slightly elongate-ovate. Antennae of nine segments, the articulation of the 3rd and 4th less pronounced than the rest. Eyes small, but prominent. Legs slender, longer than the antennae; tarsal digitules simple bristles; those of the claw very long and dilated; two strong apical spines on all the tarsi. Margin with a complete series of *inconspicuous* spinose tubercles the spines short and *truncate*; between them and surrounding them a number of large circular pores; two or three long hairs accompany each of the abdominal groups of spines. Anal lobes similar to the marginal ones. Anal ring with six hairs. Integument with a few minute scattered spines and small circular pores, the latter most numerous on the terminal abdominal segments. Length of macerated specimens, 1.7–2 mm.

Female, second stage. The marginal appendages similar in their arrangement to those in *Pseudococcus (Dactylopius) longispinus* (Targ.); but they are much longer and arranged radially; posterior pair longest. Form, after maceration, elongate. Antennae of six or seven segments. Marginal series of spinose tubercles not so clearly defined as in the adult. Integument with numerous minute spines; and there are two or three very long hairs arising from near the anal spinose lobes.

* Bull. Ent. Res., ii, p. 100, fig. 13 (1911).

Very like *P. iceryoides*, Green (Mem. Dep. Agr. India, ii, p. 26) in having a conspicuous fringe of white filaments; but in Green's species the ♀ has a "fringe of short, stout, conical spines which extend into broad clusters on the abdominal segments"; whereas in *P. gracilis* the spines are truncate and their arrangement similar to those in *P. insolitus*, Green (l.c.), but in the latter spinose tubercles are present also on the dorsum.

S. INDIA: Coimbatore, on mango, 10.ii.14; S. Kanara District, on an unnamed plant, ix.1913 (*T. V. Ramakrishna*, per E. Ballard).

***Tachardia bodkini*, sp. nov.**

Female test. Oboconical; centre with a bluntly pointed prominence, rarely with two; margin with low, blunt, and usually bifid processes, clearly the remnants of the rays of the test of the young female; surface smooth; a nipple-like prominence over the anal opening. Colour bright subtranslucent orange-red, or in certain lights faintly orange-ruby. Texture very hard and brittle, similar to that of the lac of commerce (*T. lacca*). Average length, 5.4 mm.; height, 3.3 mm.

Female, adult. Form doubtful; specimens macerated in KOH become broadly ovate when mounted under pressure. Antennae about equal in length to the greatest width of the anterior spiracles, composed of four ill-defined segments, with no trace of hairs. Post-anal spike about two and a half times the length of the antennae. Compound circumgenital glands or "tubercles" in four groups, each group consisting of over one hundred individual pores. Margin of *flattened* specimen with three pairs of large bilateral gland-tracts, the pores in each group of three distinct kinds: (a) four or five relatively large ones, with strongly chitinised subcutaneous tubes, arranged more or less in line and in the centre; (b) minute, circular and rimless pores occupying a large and roughly ovate area; (c) a complete outer ring of circular chitinous pores, resembling the circumgenital glands in the DIASPINÆ, arranged on one side of the circle in a single row, on the opposite side in an irregular band, two or three deep. The large pair of spiracles shaped somewhat like a cardinal's hat, the irregular chitinous plate surrounding them beset with circular pores. "Lac tubes" circular, the chitinised rim convex, the greatest diameter about equal to the length of the antennae; interior with relatively large pores. Anal chitinous tube shagreened, i.e., set with minute, closely adpressed spines; apical plates cuneiform or notched; anal ring with (?) ten hairs.

Female test, second stage. Five-rayed, the anterior and posterior rays longest; central area with a nipple-like prominence. Colour slightly darker than that of the adult. Length, 1.8-2 mm.

Male puparium. Subcylindrical, each extremity with a pair of short lateral rays; dorsum with a central nipple-like extension, on either side of which is a distinctly segmented, convex, median ridge. Length, 1.8 mm.

BRITISH GUIANA: near Repos, Georgetown, on *Sapium jenmani*, xii.1915 (*G. E. Bodkin*).

Froggatt* has described a species (*T. angulata*) the test of which, he says, comes to a blunt point at the apex, its general appearance resembling a large blunt

rose-thorn. This applies, in a general way, to Bodkin's specimens; but the apical extension of the test in *angulata* is fluted, whereas in *bodkini* it is perfectly smooth. The structural characters of the two species are, however, quite distinct. I have pleasure in dedicating this species to its discoverer.

***Pulvinaria aristolochiae*, sp. nov.**

Female, adult. More or less cordate in outline and rather flattened; dorsum almost completely covered with a well-defined layer of flake-like wax which varies in colour from dirty grey to greyish brown. Antennae (fig. 12, *a*) of eight segments; 3rd, 4th and 5th unusually long, the two first-named markedly swollen distally; 3rd about twice the length of the 4th; three long hairs on 2nd, one of which lies (in three examples) close up to the succeeding segment; there is also a long distal hair on the 3rd; two on the 5th; a single slender spine on the 6th, 7th and 8th, the last-named also with a few very short hairs. Legs (fig. 12, *b*) stout, long; tarsus relatively very short, less than one-third the length of the tibia; lower digitules long

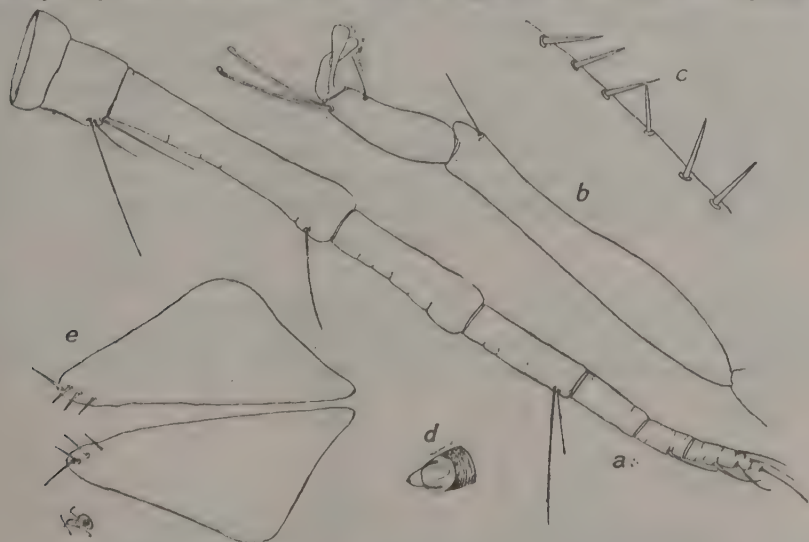


Fig. 12. *Pulvinaria aristolochiae*, Newst., sp. n., ♀; *a*, antenna; *b*, leg; *c*, marginal spines; *d*, submarginal tubercle; *e*, anal lobes.

and very broadly spathuliform. Marginal spines (fig. 12, *c*) stout, pointed and placed rather closely together; stigmatic spines broken away in all the specimens, their points of attachment being *continuous with the marginal series*. Submarginal pores (fig. 12, *d*) very large, continuous, but rather widely separated. Anal lobes (fig. 12, *e*) with four stout spines near the apex, on the inner edge. Anal cleft short, usually a little less than one-sixth the entire length of the body. Anal ring with *eight* hairs. No derm cells present; but there are numerous circular spinnerets (? ventral), each having an inner concentric ring. Length, 5·7–7·6 mm.

Ovisac pure white and closely felted, long and generally tortuous. Length, 10–20 mm.

GOLD COAST: Aburi, on *Aristolochia* sp., (W. H. Patterson).

The affinities of this insect are with *P. maxima*, Green, and *P. jacksoni*, Newst., but it differs from both in having pointed marginal spines, and from the latter species by the much denser and shorter ovisac.

***Pulvinaria elongata*, sp. nov.**

Female, adult (fig. 13, *e*). Extremely elongate or elliptical, extremities more or less equally attenuated; dorsum convex, cephalic region flattened. Colour, in life, varying from very pale crimson to bright rosy flesh-colour, with two more or less distinct, longitudinal lines of bright crimson, the latter frequently interrupted by a black wavy loop-like line, due apparently to a portion of the alimentary tract

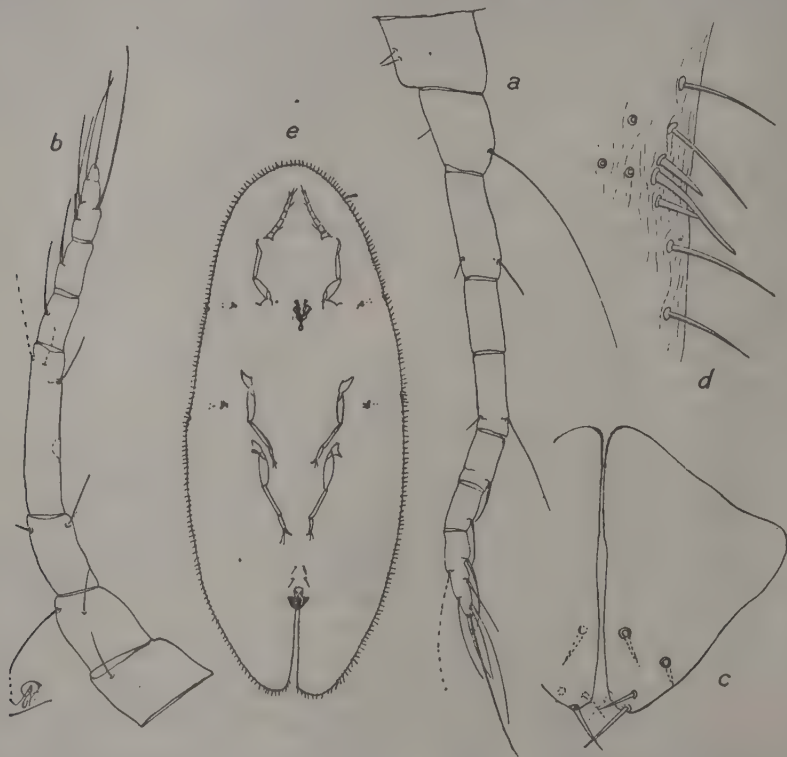


Fig. 13. *Pulvinaria elongata*, Newst., sp. n., ♀; *a*, normal 8-segmented antenna; *b*, 7-segmented antenna; *c*, anal lobes; *d*, stigmatic cleft; *e*, adult ♀.

(? Malpighian tubules). Dry cabinet specimens are pale buff, with a broad median suffused area of smoky brown or red-brown, and often with a well-defined median keel. The ovisac is very short indeed, projecting but slightly beyond the margin; it extends anteriorly, usually as far as the region of the eyes. Antennae (fig. 13, *a*) normally of eight segments, of which the 3rd is slightly the longest; in two individuals the antennae are asymmetrical, one being composed of seven segments (fig. 13, *b*) the other of eight; in the former the 4th is twice the length of the 3rd,

but it shows a partial subdivision. Legs long and somewhat slender; tarsal digitules nearly as stout as those of the claw, the latter with disc-like terminals. Anal lobes (fig. 13, *c*) with four stout spines; one apical, the others arranged in a triangle; beneath each scale are four to five very long stout hairs, which are apparently attached to the eversible sac; their number and arrangement is somewhat exceptional. Abdominal hairs very long, in two pairs. Circumgenital pores numerous, extending beyond the anal plates. Anal ring with six unusually long, stout hairs. Stigmatic cleft (fig. 13, *d*) practically obsolete; spines three, the middle one about twice the length of the laterals; margin with relatively long and very stout hairs. No derm cells present. Length, 3.5–6 mm.

Larva. Narrowly elongate. Lateral margins with widely separated, stout hairs; frons with nine to ten similar but much longer and stouter hairs or spines; these are packed closely together and give the insect a strikingly characteristic appearance. Anal lobes each with an immensely long hair. Stigmatic spines well developed, but the longest of the three is less than half the length of the marginal hairs.

BRITISH GUIANA: Georgetown, "on blade of sugar cane," 12.ii.13 (*G. E. Bodkin*).

In its general external appearance this Coccid bears a rather striking resemblance to a member of the genus *Aclerda*, owing to its elongated form and the small amount of white secretion beneath the insect, but it has no real affinity with this genus, and although the ovisac is but slightly developed, it cannot be considered as generically distinct from *Pulvinaria*; neither can it be placed, so far as one can judge, in either of the allied genera *Tectopulvinaria* or *Protopulvinaria*.

***Pulvinaria* ? *flavicans*, Mask.**

Female, adult. Dead examples shrivelled and resembling a shapeless mass of dirty, amber-coloured beeswax; dorsum in some examples with detached fragments of glassy secretory matter, with here and there particles of a white felted substance.

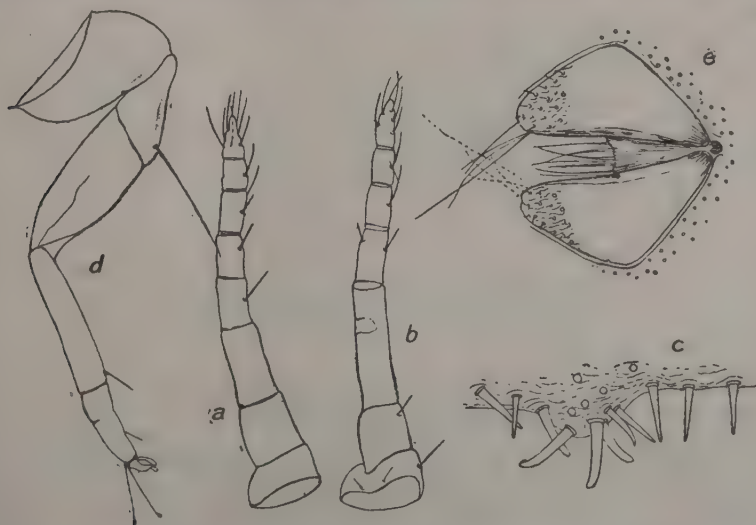


Fig. 14. *Pulvinaria* ? *flavicans*, Mask., ♀; *a*, *b*, antennae; *c*, stigmatic and marginal spines; *d*, leg; *e*, anal lobes.

Marginal spines visible under a two-inch objective. Ovisac very short, slightly overlapping the sides of the female, and most pronounced posteriorly. Specimens attacked by Chalcidid parasites are very elongate, highly convex and of a red-brown colour; no ovisac was formed by them. Length of ♀ and ovisac, 2·3 mm.

After treatment in KOH the form is more or less ovate or broadly pyriform. Antennae (fig. 14, *a*) normally of eight segments, rarely of seven; in the latter case the 3rd and 4th are either completely fused or only partly so (fig. 14, *b*); hairs on the terminal segments relatively short. Marginal spines (fig. 14, *c*) long, stout and pointed; they are placed closely together, the space between them being much less than their length, more especially so are they on the frons and the distal margin. Stigmatic clefts obsolete; stigmatic spines (fig. 14, *c*) usually six in number, of which two pairs are much larger than the others, broad, curved and flattened. First pair of legs (fig. 14, *d*) with the tarsus bearing a well-defined dorsal constriction. Anal lobes (fig. 14, *e*) with the distal portion thickened, convex, and with many fine hairs; beneath the tips are two pairs of long slender hairs, one pair being a little more than half the length of the lobe. Anal cleft slightly less than one-fifth the length of the insect. Anal ring with ten hairs. Circumgenital glands small, but very clearly defined. Venter, just in advance of lobes, with two pairs of hairs, one pair much longer than the other. No derm glands or pores traceable. Length, 2·2-5 mm.; width, 1·5-2·6 mm.

BRITISH GUIANA: Rockstone, on "blood-wood" plant, 30.xii.13 (*G. E. Bodkin*).

A species of ant had built little shelters or "tents" over some of the females.

***Pulvinaria subterranea*, sp. nov.**

Ovisac. White and felted and, when complete, very elongate, with traces on the proximal portion of 3-4 longitudinal grooves; incomplete forms more robust and decidedly more convex. Length of elongated forms, 3·5-4·5 mm.; short forms, 2-2·5 mm.



Fig. 15. *Pulvinaria subterranea*, Newst., sp. n., ♀; *a*, *a*, antennae; *b*, stigmatic cleft and marginal spines; *c*, anal lobe.

Female, adult. Tilted and shrivelled at gestation; after treatment in KOH broadly ovate. Colour pale brown. Antennae (fig. 15, *a, a*) usually of eight segments, rarely of seven; in the former case, the 4th is shorter than the 5th, and the 3rd the longest; in the example with seven segments the 4th, 5th and 6th are equal, the 3rd and the 6th are also of equal length and the longest. Legs very robust; lower digitules stout and strongly dilated. Stigmatic clefts (fig. 15, *b*) barely indicated; spines three, the laterals about half the length of the central one and much the stoutest. Marginal spines (fig. 15, *b*) long and for the most part faintly frayed distally; those at the anal margin slightly the longest; they are somewhat irregularly arranged and in places are two deep. Anal cleft about two and one-fourth times as long as the lobes; the latter (fig. 15, *c*) somewhat variable, with one apical and generally two subapical bristles. Derm glands scarcely traceable, even in well stained specimens, and then only in one or two places as small and approximately oval spots. Length, 1.5–2 mm.; width, 0.95–1.5.

UGANDA: Entebbe, on roots of *Chrysanthemum*, 10.iii.14 (*C. C. Gowdey*).

***Pulvinaria africana*, sp. nov.**

Female, adult.—More or less ovate, narrowed anteriorly. Colour (in formol) dull amber-yellow; surface of many individuals with a faint black network formed by the mycelium of a fungus. Ovisac closely felted, elongate, with the sides more or less parallel, straight or curved; surface usually with four well-defined, rounded, longitudinal keels, and transverse conchoidal wrinkles. Antennae (fig. 16, *a*) normally

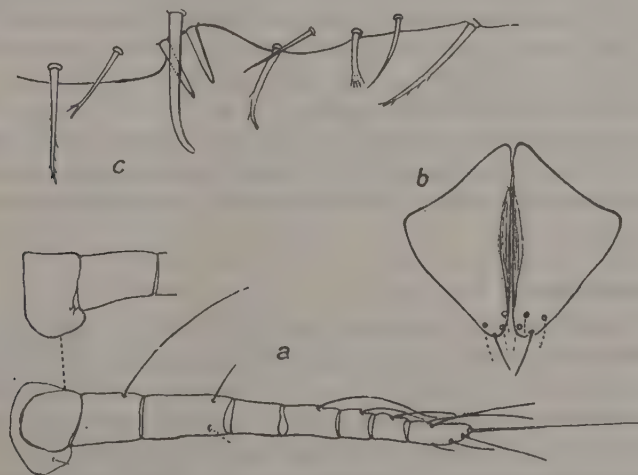


Fig. 16. *Pulvinaria africana*, Newst., sp. n., ♀;
a, antenna; *b*, anal lobes; *c*, stigmatic cleft and spines.

of eight segments, of which the 3rd is slightly the longest; formula: 3 (2, 8) 1, (4, 5) (6, 7); in one example the antennae are asymmetrical:—one being normal, the other of six segments only, of which the 4th is much the longest. Legs somewhat robust; anterior tarsi with a median constriction. Anal cleft short, about twice the length of the lobes or one-eighth the length of the body. Anal lobes (fig. 16, *b*)

with four or five apical bristles. Stigmatic clefts (fig. 16, c) clearly defined but small; spines three, all of them stout and bluntly pointed, the central one curved and a little more than twice the length of the laterals. Marginal spines (fig. 16, c) in two irregular rows: these are of two forms: one long and stout, with fine lateral hairs; the other much shorter, usually simple, but here and there one may be found with a divided tip. Arising from near the insertion of each antenna is a group of three bristles, each successively longer than the other, the longest being nearly equal in length to the 2nd and 3rd segments of the antennae together. Derm cells irregularly oval or circular, but these are quite obscure in the majority of the specimens. Length, 1.8–2.2 mm. Length of ovisac, 3.5–4 mm.; width, 1.5 mm. (average).

GOLD COAST: Accra, on guava, 2.viii.16 (*Dr. J. W. Scott Macfie*); heavy infestation.

Clearly this is not *Pulvinaria psidii*, Mask., as defined by either Maskell* or Green†. It differs in a marked degree in the form of the ovisac, and also in the character of the marginal spines, which are not dilated and dentate distally and are moreover, so far as I can judge, relatively very much larger, more irregularly arranged and not nearly so uniform in length. It is also not specifically identical with the specimens of *P. psidii*, Mask., recorded by me in this Bulletin (Vol. i, p. 67, and Vol. ii, p. 94). Many of the examples were attacked by a parasitic fungus, and they were also preyed upon by a predaceous Lepidopterous larva, of which there were several examples. A description of the cocoons of the latter is appended below.

Larva with the whole of the upper surface protected by a tough silken cocoon, into which is incorporated the remains of the Coccid (*Pulvinaria africana*, Newst.) and its ovisac; the bodies of the female Coccids often more or less intact; the remains of the ovisacs are sometimes arranged in narrow spiral-like bands, or they may completely cover the semi-cocoon. Plant hairs and the mycelium of a fungus also present. Ventral surface of the larva nude.

Cocoon, containing a parasitised pupa, complete, but thinner on the ventral surface than elsewhere. The general form is slightly more elongate than the semi-cocoon of the larva. Comminuted remains of the Coccid and its ovisac incorporated, as in the cocoon of the larva.

***Ceroplastes avicenniae*, sp. nov.**

Female test. More or less hemispherical, smooth and more or less evenly rounded, with very faint traces of plates, apparently arranged as follows: one dorsal, one anterior, two bilateral and one anal; in each of the first three is a dark brown or almost black nuclear spot with a white centre; the anal plate with three similar spots placed closely together, the central one, formed by the tip of the caudal process, being without a white centre. Two examples gave the following measurements: (1) length, 7.5 mm., diameter, 7 mm., height, 6 mm.; (2) length, 7 mm., diameter, 6 mm., height, 6 mm.

Female, adult. Semiglobular in shape, but slightly longer than broad; integument highly chitinated but thin; submarginal tubercles well developed and five in number;

* N.Z. Trans., XXV, p. 223 (1892).

† Coccidae of Ceylon, p. 264 (1909).

one cephalic and two bilateral, each of the latter placed just above the stigmatic clefts; median dorsal tubercle prominent and keel-like. Caudal process long, stout, measuring 1.2–1.3 mm. long. Frontal margin slightly produced; posterior margin, immediately beneath the caudal process, with a similar projection but wider and with a median division (anal cleft). Stigmatic clefts quite small and shallow. Antennae of eight segments, of which the 3rd, 5th, and 8th are the longest. Stigmatic spines minute, conical, arranged three to four deep, centrally, but diminishing in number bilaterally at the extreme margin. Legs normal, as far as can be traced. Gland pores of the integument simple, somewhat thinly and irregularly scattered. Marginal spines not traceable in the three females examined.

BRITISH GUIANA: Mahaica Creek, on courida (*Avicennia nitida*), viii. 1916 (G. E. Bodkin).

The old adults when denuded of the test are very like those of *Ceroplastes ceriferus* (Anderson), but the caudal process is slightly shorter and the number and arrangement of the submarginal tubercles differ in a marked degree. Only one antenna has been studied, and this, so far as one can judge, consists of eight segments, but the articulations are ill-defined and difficult to trace; clearly however it is markedly different from that of *C. ceriferus*.

***Ceroplastes bipartitus*, sp. nov.**

Female test. Colour, in dried specimens, very like pale dirty beeswax. In the young adults the test is broadly oval, somewhat hemispherical and divided into nine plates: three bilateral, one cephalic, one anal and one dorsal, the last-named with a conspicuous dark brown or blackish, oval spot, with a central elongated patch of pure white wax; the nuclear spots to the lateral plates are smaller and generally much less conspicuous than the dorsal one. Margin over the stigmatic areas with a pair of laterally compressed and somewhat disc-shaped extensions, each extension carrying on its edge a narrow strip of opaque white wax, the tip of which sometimes reaches the dark nuclear spot of the lateral thoracic plate. In very old examples the test has increased in thickness considerably, but this has been so much damaged in transit as to render it useless for descriptive purposes; however, one can trace the curious marginal extensions, which are somewhat like a narrow-waisted and distorted bobbin, or the toy used in the once popular game "diabolo." Average length of young adults, 3 mm.; height, 1.6–2 mm.; average length of old adults, 6 mm.; height doubtful.

Female, adult. Denuded of wax, hemispherical; caudal process very long, varying in length from one-half to a little less than one-half the length of the remaining portion of the insect. Submarginal tubercles small, but generally clearly defined: one cephalic and three bilateral, the two over the stigmata slightly more pronounced than the rest. When examined under a high power lens, by transmitted light, these tubercles are seen to be traversed by clear cell-like tracts forming an irregular reticulated pattern. It is reasonable to assume, therefore, that these may be the special set of glands which secrete the nuclear spots in the centre of the plates in the test. Derm relatively thin, but strongly chitinised. Pores minute, separated over a large portion of the dorsum by slightly varying distances equalling the length of one of

the short segments of the antennae or two of them together. Stigmatic clefts (fig. 17, *b*) relatively shallow, but very clearly defined; spines short, obconical, those at the extreme margin very minute and stud-like. Marginal spines or hairs not traceable. Antennae (fig. 17, *a*) of six segments, the 3rd longer than the last three together. Legs normal. Length of denuded female, inclusive of the caudal process, 4.5–4.6 mm.; length of caudal process, 1.3–1.5 mm.

Male puparium (fig. 17, *e, e₁*). Consisting of two distinct parts; the lower half boat-shaped, and of a glassy, vesicular texture, as in those typical of the genus *Lecanium*; the upper portion *opaque*, low, convex, and of a dirty beeswax colour, with nine narrowly rectangular, submarginal patches of snow-white secretion. Anal

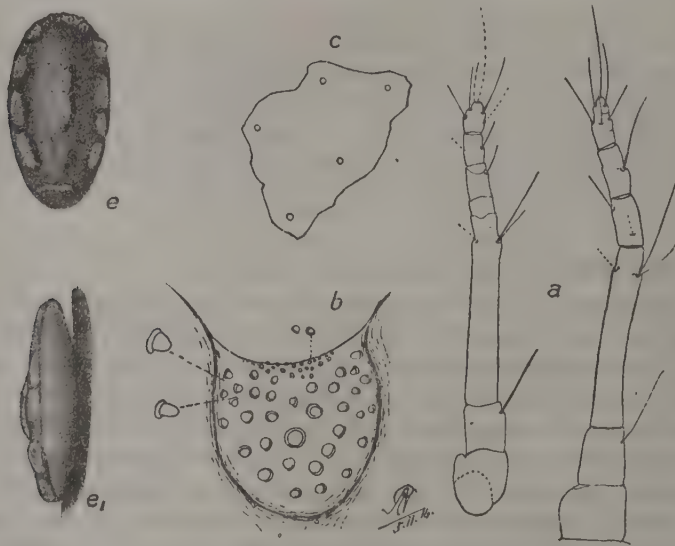


Fig. 17. *Ceroplastes bipartitus*, Newst., sp. n. : *a*, antennae of ♀; *b*, stigmatic cleft of ♀; *c*, derm of ♀; *e, e₁*, puparium of ♂, dorsal and lateral views.

cleft apparently obsolete. On the emergence of the male the whole of the upper portion falls away, leaving the ventral half attached to the food-plant. The line of cleavage between the upper and lower portion is clearly defined in those puparia from which the imprisoned male has not escaped. Length, 1.6 mm.

SOUTH AFRICA, 1914 (*de Charmoy*).

***Ceroplastes destructor*, sp. nov.**

Ceroplastes ceriferus (Anderson) Newstead, Bull. Ent. Res. i, pp. 66, 195 (1910).

Female test. White, creamy white or dirty white; exceedingly soft and containing an excess of moisture. Form irregular, with large but ill-defined gibbose protruberances; sides usually with two narrow opaque lines of secretion from the stigmatic clefts. No trace of lateral plates. Length, 5–8 mm.

Female, adult. More or less hemispherical, with the sides often slightly compressed; caudal process long; integument castaneous and highly chitinated, smooth and

shining, and without fovea or lateral tubercles. Antennae of six segments, the 3rd being as long as the 4th, 5th, and 6th together; the last three segments with stiff and bluntly pointed, spinose hairs. Legs small; hind femora very short and often distinctly incrassate; hind tarsi equal in length to the tibiae, or sometimes slightly longer. Claw very short; lower digitules very long and stout; upper digitules normal. Stigmatic clefts well defined, but relatively small; stigmatic spines very small and pointed, bases not constricted; basal attachment (disk) very large. Caudal process (after maceration) transparent and somewhat flexible; sides with an irregular double row of short spinose hairs, and in addition to these there are two pairs of longer hairs (one pair of which is twice the length of the others) slightly ventral to the row of short ones and towards the distal extremity. Anal lobes short and highly chitinised. Dorsal pores very small, rather widely separated. Ventral integument opposite the caudal process, with rather extensive groups of circular pores, many of which, in well cleared specimens, are linked together with lines of dark chitin. Length, 4-7 mm.

Female, second stage. Pyriform, the sides without tubercular projections; caudal process long. Eyes relatively large. Antennae of six segments and very similar



Fig. 18. *Ceroplastes destructor*, Newst., ♂; a, antenna; b, puparium.

to those of the old adult female. Legs small; tibiae and tarsi of equal length. Stigmata large; parastigmatic glands extending in a broad band to the stigmatic clefts. Stigmatic spines 40-50 in number, one of which is considerably larger than the rest; there is also a single long simple spine on either side of the group, near the extreme margin. Ventral group of circular pores slightly larger than those in the adult, and the chitinous strips connecting them are absent. Dorsum thickly studded with spinnerets, which are interspersed with short stout spines dilated distally. Caudal process absent. Length, 2-3.7 mm.

In the second larval stage of the female the waxen appendages are arranged in a very similar way to those in *Ceroplastes ceriferus*, Anderson.

Male puparium (fig. 18, b). Elongate, faintly yellowish white or faintly greenish yellow; texture hard, glass-like and opalescent; dorsum with a central boss-like patch of white secretion; margins with three relatively large, opaque, white appendages, which are often sub-divided. Anterior extremity with three similar but much

smaller appendages, the outer ones diverging from the central one; these processes are however often wanting and seem to be readily abraded; many of them are also strongly recurved over the dorsum. Length, 1.5–1.7 mm.

Male. Dried examples dull red-brown or dusky brownish-crimson. Ventral ocelli in a single pair. Antennae (fig. 18, *a*) short and stout and of ten segments. Genital armature styliform and very long. No visible trace of caudal filaments, though the usual organs for the attachment of these are present. Wings strongly and beautifully iridescent, and when seen by direct light the membrane appears distinctly and regularly punctate.

This *Ceroplastes* has twice previously been recorded (*loc. cit.*) as being doubtfully referable to *C. ceriferus*, Anderson; and this chiefly because of the striking similarity of the old adult females to those of the latter. With a more extensive series of specimens, in all stages, one has been able to gather that the Uganda insect is in many ways markedly distinct; more especially so are the young adult females, the male and its puparium.

***Ceroplastes egbarum*, Ckll.**

Male puparium. Narrowly elongate; ventral half shaped like a shallow boat, opaque glassy white; upper half also glassy *beneath*, but covered with a thick, opaque, creamy-white layer of wax; with or without a median depression, in the

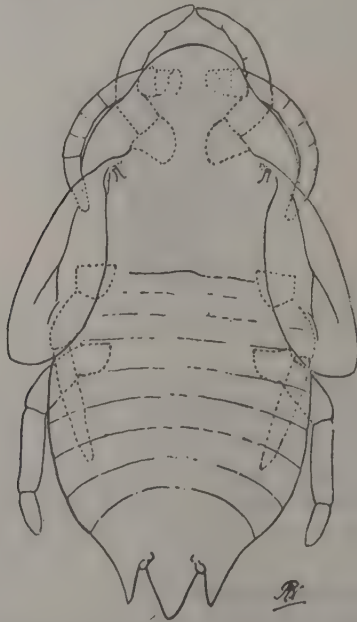


Fig. 19. *Ceroplastes egbarum*, Ckll., ♂ pupa, $\times 130$.

centre of which is a very short elongated process of white faintly segmented secretion, which is broadly divided transversely in the centre. Marginal processes similar; three on each side and two cephalic. The dorso-ventral scales are rather widely

separated distally from a point near the centre of the puparium, so that the terminal portion of the abdomen of the enclosed pupa is more or less exposed. The examples submitted are grouped together in long narrow colonies, two or three abreast, one overlapping the other with, generally, the lower half of the puparium only exposed. Length, 2·2-2 mm. ; width, 1 mm.

Pupa (fig. 19, a). With well developed wing-pads and three large anal tubercles. Length, 2 mm.

Pro-pupa. Antennae of six segments, of which the 3rd and 6th are longest, the former longest of all. Stigmatic spines three, narrowly conical, the central one the longest. Marginal hairs few and widely separated. Just within the margin is a series of exceptionally long subcutaneous gland-tubes, which are placed rather closely together.

GOLD COAST : Tamale, on *Pithecolobium saman*, 31.i.16 (C. Saunders).

The discovery of the male puparia is of much interest. They were attached to the same branch as two of the females, but were slightly separated from the latter.

***Ceroplastes lamborni*, sp. nov.**

Test of old adult female. Conical, more or less vertical in front and sloping upwards and forwards from the caudal process ; sides with faint traces of three stigmatic plates. The four white stigmatic processes extending beyond the margin. Colour, in old dried examples, dusky red-brown and somewhat oily in appearance. Texture hard and almost as brittle as resin. Length, 3·5 mm. ; height, 3·5 mm. A slightly larger example was also submitted, but this was imperfect.

Female, old adult. Dorsum obconical, with a deep constriction at the base in a line with the caudal process ; sides below the constriction bulging and irregular ; cephalic lobe well defined. Stigmatic clefts deep, but relatively small. Caudal process very short, piceous. Integument shining, dull castaneous ; the conical projection of the dorsum with obscure black and more or less confluent spots. Antennae of six segments, the 3rd much the longest and occasionally with a partial sub-division, the length equalling the three succeeding segments ; formula : 3, 2, 6, 1 (4, 5). Legs normal. Stigmatic spines small, conical and arranged in a relatively large, compact group ; one of them, near the centre, is slightly larger than the rest. Dorsal pores small, with a minute cylindrical *external* projection resembling a truncated spine ; intervening spaces faintly reticulated. Marginal spines traceable only in places, minute and hair-like.

Female test, second stage. Somewhat rectangular in outline ; dorsum with a well-marked and somewhat angular prominence, behind which, immediately over the anal orifice, is a broad tongue-shaped plate of dull white secretion ; sides with three well-defined plates ; stigmatic processes pure white and projecting considerably beyond the margin, when perfect. Spaces between the plates and elsewhere translucent, the colour of the sublying insect showing faintly through. Texture hard and brittle.

Female, second stage. Elongate, narrowed and produced in front, truncate posteriorly ; dorsum with a strong keel or, in more advanced specimens, a fusiform swelling, surrounded by a deep channel ; sides more or less vertical ; venter flat ; eyes prominent ; cephalic lobe strongly produced. Stigmatic clefts well defined.

On maceration in KOH the integument is thin and transparent, with the exception of a small portion surrounding the minute caudal process. In very young females the test is ovate, opaque and glassy, with a very elongated plate of buff-yellow secretion, the posterior end of which rests against the naked caudal process. Stigmatic processes pure white and projecting beyond the margin.

SOUTHERN NIGERIA: Ibadan, on cacao and "on a large climber on bush tree" (Dr. W. A. Lamborn).

The tests of the old adults bear some resemblance to those of *Ceroplastes coniformis*, Newst., but are markedly distinct. There is a striking, indeed a remarkable, difference between the young and old examples, but their structural details are specifically identical.

***Ceroplastes subdenudatus*, sp. nov.**

Female test. Incomplete, covering only the central portion of the dorsum of the ♀; this is more or less bluntly conical, the apex with an irregularly pointed patch of dull white wax, sometimes faintly stained with yellow or yellowish brown, with a central nuclear spot; the rest of the body of the ♀ with a thin transparent coating of varnish-like secretion; stigmatic processes white, thread-like and curly, resting upon the sides of the ♀. Greatest diameter, 2.5–3.4; height, 2.3–3.6 mm.

Female, adult. Somewhat hemispherical, but the height is slightly greater than the diameter at the base, the latter circular in outline. Cephalic lobe and stigmatic clefts rudimentary. Caudal process rudimentary and placed, as a rule, just above the middle line between the margin and the centre of the dorsum. Surface shining, faintly wrinkled at the sides. Antennae relatively small, of seven segments; 4th much the longest; formula, 4, 2, 3, 7, 1 (5, 6), or the 7th may equal the 3rd; long stout spines on the last three segments. Stigmatic spines of two types; those at the margin stout and pointed, forming a group of 15–16; the inner group obconical and numbering 19–22. Marginal spines similar to the pointed ones in the stigmatic clefts; very few at the sides, but they are placed closely together on the cephalic margin. Postanal arch of chitin with a well-marked series of circular pores.

Two specimens gave the following measurements: (1) diameter, 2.4; height, 3.3; (2) diameter, 3.2; height, 3.5 mm.

UGANDA: Entebbe, on *Acacia* sp., 7.iv.14 (C. C. Gowdey).

Easily distinguished by the apical patch of white wax and the unusually long 4th segment of the antennae.

Ceroplastes vuilleti*, Marchal.

Puparium of male. Elongate. Colour of the dorsal half somewhat like that of dirty beeswax, with seven relatively large protuberances partly covered with dirty white, granular wax; one anterior, three bilateral and one central. Lower half shaped like a shallow boat; posterior extremity often tilted upwards, with a narrow transverse slit between the dorsal and ventral portions. Inner surface dirty grey. Length, 1.4–1.5 mm.; width, 0.7–0.8 mm.

* Bull. Soc. Zool. France, 1909, p. 68; Mem. Soc. Zool. France, xxii, p. 165 (1909).

The specimens are badly weathered and discoloured, so that too much importance must not be attached to the colour of the puparia as given above. It is highly probable that the protuberances of the dorsum were pure white when quite fresh and that the texture was also more or less glassy.

Female, adult. Marchal (*l. c.*) has described the female and its test, in detail; but there are some structural points which need elaboration and these are appended below.

Antennae (fig. 20 *a, a*) of eight segments, the articulations of the last four segments appearing very broad owing to the thinning down of the surrounding chitin; in one example the 4th and 7th segments show partial but irregular and incomplete articulation. Another example has the normal number of segments on one side, and on the other only six; the latter is clearly malformed, owing possibly to the presence of Chalcidid parasites. Legs normal; lower pair of digitules not so markedly dilated as is usual in the members of this genus; tarsi shorter than the tibiae. Dorsal pores (fig. 20, *b*) very numerous; the intervening spaces finely and faintly reticulated in the more highly chitinated portions. Stigmatic clefts deep and

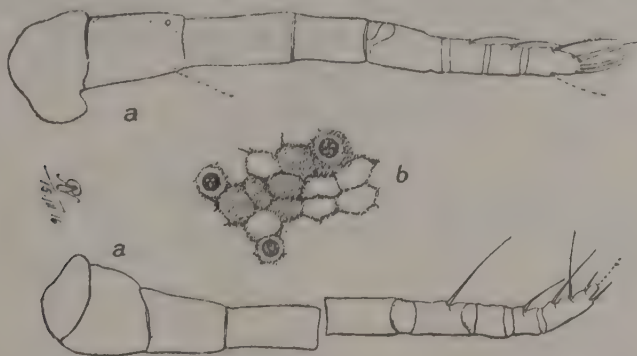


Fig 20. *Ceroplastes vuilleti*, Marchal, ♀; *a, a*, antennae; *b*, derm glands.

broad; the spines at the outer edge relatively long and pointed; the broadly ovate, inner group very short, conical and placed *closely together*; one in the centre of the group is larger than the rest. Marginal spines similar to those at the edge of the stigmatic clefts, but smaller and widely separated. A number of minute spines are scattered over the dorsum.

Marchal found one antenna with nine segments, but states that the additional segment was probably due to the sub-division of the 8th. His description and figure of the stigmatic cleft and the marginal spines is correct, but he evidently failed to determine the true character of the group of minute conical spines on the interior of the clefts. Apart from these details my examples agree with the rest of Dr. Marchal's description and figures.

S. NIGERIA: Agege and Ibadan, abundantly on pigeon-peas, 1913 (*Dr. W. A. Lamborn*).

Dr. Lamborn is to be congratulated on the discovery of the male puparia, as little is known, comparatively speaking, of the males or their metamorphoses in this genus.

Ceroplastes zonatus, sp. nov.

Female test. Broadly ovate in outline, highly convex; marginal plates very faintly indicated, but apparently without nuclear spots; dorsal plate very large, with a central nuclear spot of white wax; cephalic margin slightly clypeate; lateral margins in very old examples with a pronounced foot-like extension from each of the stigmata, from which there extends a thick white waxy appendage. In the younger forms the foot-like extension is wanting, but the white waxy appendages are present and always porrected. Colour creamy white, suffused with very pale brown; dorsal plate surrounded by a shaded wavy zone of dark brown and brownish black, with here and there a suffused patch of dull flesh-colour. In very old examples the zone of colour extends to the margins and is of a shining madder-brown to piceous colour. On the removal of the outer surface of the test with chloroform, it is seen to be divided

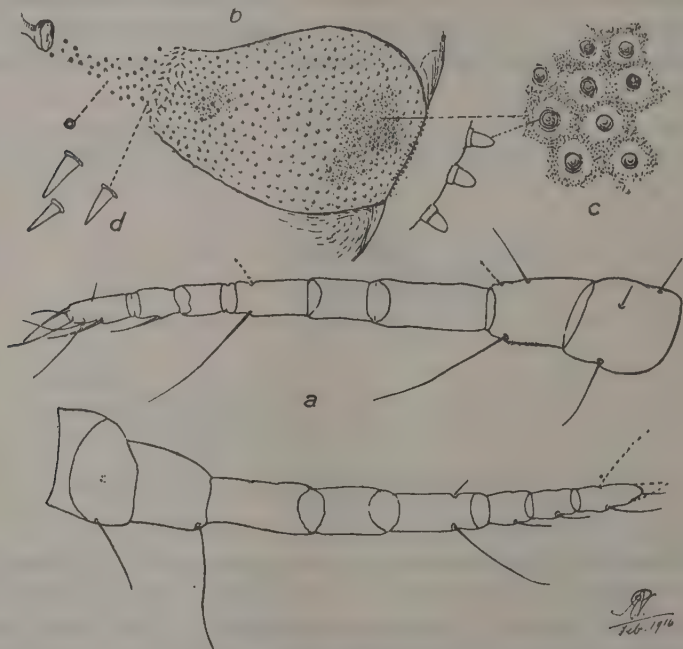


Fig. 21. *Ceroplastes zonatus*, Newst., sp. n., ♀; a, antenna; b, stigmatic cleft, with spines; c, portion of anterior group of spines; d, portion of proximal group of spines.

into seven areas by pale orange-coloured lines; a central polygonal area, corresponding to the area occupied by the dorsal plate, from the angles of which radiate to the margin single lines marking off the areas of the lateral and cephalic plates.

Female, adult (denuded of the test). Ovate; cephalic margin clypeate; dorsum low and wrinkled; two large, bilateral, submarginal extensions, both longitudinally striated; the space between these extensions of the body-wall and the margin markedly constricted. Dorsum with a large keel-like process. Caudal process very short and conical. Stigmatic clefts deep. Antennae (fig. 21, a) of eight segments; the articulations relatively very broad; 3rd about equal in length to the 7th and 8th

together; a very long hair on the 2nd and 5th, and a slightly shorter one on the 8th; there are two spines on the 8th and one on the 7th. Legs normal. Stigmatic spines (fig. 21, *b*) covering a large and somewhat pyriform area, the length of which is nearly equal to twice the length of the antennae; the spines, with the exception of a small group near the stigmata, are obconical and the space between them with bands of dark granular bodies, which collectively form a polygonal reticulation (fig. 21, *c*); the small proximal group of spines (fig. 21, *d*) are longer than the others and pointed. No trace of marginal spines. Derm thin and transparent after maceration; rather thickly set with minute pores and minute scattered spines. Caudal process surrounded by a porose zone of brown chitin. Length, 3·9–4·6 mm.

SOUTH AFRICA: 1914 (*E. d'Emmerez*).

***Inglisia theobromae*, sp. nov.**

Female test (fig. 22, *a*). Strongly bilobed, the lobes forming two cones, which are confluent at their bases; each cone is rounded ventrally and almost flat dorsally, with the ends truncated. In the younger forms the cones are fixed at an angle of, approximately, 45°; in the old adults they are much more diverted and in some

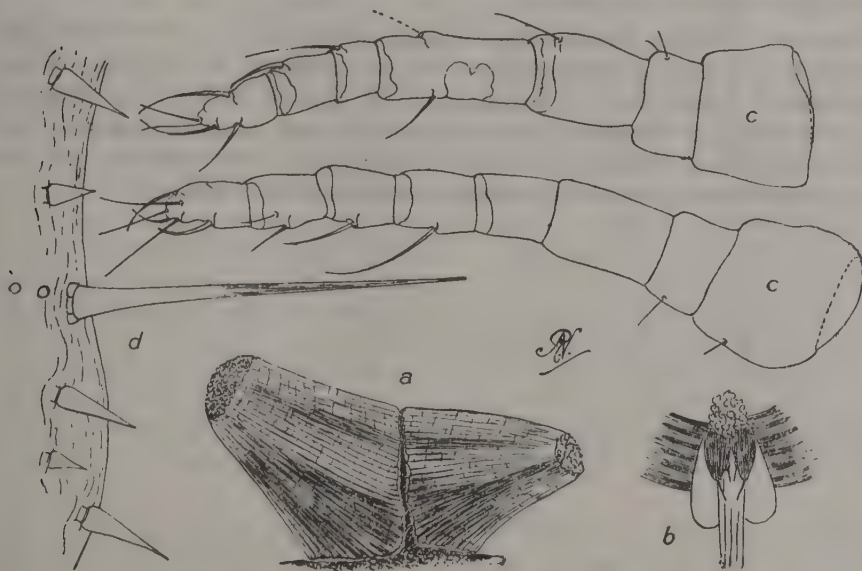


Fig. 22. *Inglisia theobromae*, Newst., sp. n., ♀; *a*, test; *b*, anal appendages of test; *c*, *c*, antennae; *d*, stigmatic and marginal spines.

instances assume an almost horizontal position. The cones are strongly fluted vertically and very finely striate transversely. Colour pinkish buff with a faint pearly lustre. Anal aperture (fig. 22, *b*) in the young adults with a pair of thin, translucent, waxy plates, upon which there rests a pencil of thick, white, waxy filaments with truncated ends; the latter are held in place by the anal lobes and their accompanying bristles. Above the lobes a small irregular mass of dusky secretion.

Length, between the extremities of the cones, 4.5 mm.; height of middle line, 2 mm. Young adults measure: 2.2 mm. between the extremities of the cones, and 1.5 mm. along the middle line of the dorsum. These may be taken as average measurements.

Female, adult. Shape similar to that of the test, but shrivels on drying, so that the test readily falls away in two parts. Antennae (fig. 22 *c, c*) of seven or eight segments; in the former case the 4th is the longest, but invariably bears one or more partial divisions; in those having eight segments the 3rd is the longest. Stigmatic clefts obsolete, the position occupied by a single long spine (fig. 22, *d*) which is equal in length to two-thirds of the antenna; it is sometimes strongly curved at the end. Stigmata just within the margin and between them three to four circular pores. Marginal spines (fig. 22, *d*) in an irregular row, and of two sizes; all are conical and sharply pointed. Anal orifice surrounded by a very long loop-shaped band of dense chitin. Anal lobes pointed; inner edge with two tubercular projections; the tubercles and the tip each with a spine, and there is also a very large spine attachment in the middle of the apical projection. Anal ring with six hairs. A narrow line of dorsal pores extends from the anal lobes to the region of the proboscis; the latter relatively small and the mentum monomeric.

UGANDA: Nagunga, on stems of cacao pods and flowers, 18.ix.15 (*C. C. Gowdey*).

In the form of the test this species bears a close resemblance to *I. castilloae*, Green,* but differs in having the ends truncated, in the absence of the "deep transverse furrow extending downwards from the apex of each cone" and the "rounded lips" forming the border behind and in front. Furthermore, the female of *I. castilloae* has no stigmatic spines, and the antennal characters are also different.

* Jour. Econ. Biol., vi., p. 29, pl. i. (1911).

NATURAL TRANSMISSION OF TRYPANOSOMIASIS (*T. PECORUM* GROUP) IN THE ABSENCE OF TSETSE-FLY.

By RUPERT W. JACK, F.E.S.,

Government Entomologist, Southern Rhodesia.

(MAPS I & II.)

The opinion that trypanosomiasis of the *T. pecorum* type is, under favourable conditions, transmissible amongst domestic stock through the agency of blood-sucking flies other than *Glossina* has been expressed by several observers.*

Observations in Southern Rhodesia during the past seven years have convinced the writer that, given the necessary conditions, transmission of this disease may take place in the absence of tsetse-fly, and that such transmission has occurred more frequently than has been generally recognised. It may be of interest therefore to give the facts concerning several outbreaks in the territory which form a chain of evidence pointing to the above conclusion. The trypanosome was in each case diagnosed by Mr. Ll. E. W. Bevan, Veterinary Bacteriologist, S. Rhodesia :—

I. *T.'s cattle.* Farm on railway about 3 miles N.E. of Gatooma. Season 1909–10. Ten cattle were brought to farm about 26th October 1909, from Victoria, but had been by rail to Salisbury and back to Gatooma. Two were brought to farm about 6th December. At the time of my visit, 31st January, the two latter were healthy ; but the remainder, of which one had already died, were all “fly-struck,” the first case having been noticed during the first week in January. The range of the cattle was confined to the farm, the road between the farm and Gatooma and across the railway to the Cam mine. Fly is known to exist 3 to 5 miles to N.E. (see Map I). The writer spent a full week looking for fly on this farm and in the vicinity with negative results. A few specimens of *Tabanus* and a few *Stomoxys calcitrans* were seen about the cattle. Early in March the two remaining cattle fell sick and were diagnosed by Bevan as suffering from trypanosomiasis. Since that year cattle have lived in a healthy state on this farm.

II. *H.'s cattle.* Farm within 2 miles of Gatooma to S.E. Season 1909–10.

Forty cows were on the farm for sixteen months and out of these nineteen showed symptoms of trypanosomiasis (diagnosed by Bevan). The only occasion on which any left the farm was from August to November, 1909, when all but six went to the Inez Mine (opposite direction to the fly belt). The first case was recorded in July 1909. *Stomoxys calcitrans*, *Lyperosia* sp. and two species of day-feeding mosquitos were common about the range of the cattle. No tsetse was seen on or near this farm,

* (1). Kinghorn & Montgomery : “A Report on Trypanosomiasis of Domestic Stock in N.W. Rhodesia.”—*Ann. Trop. Med. Parasit.*, June, 1908.

(2). G. E. Owen : “Mechanical Transmission in Trypanosomiasis.”—*Jl. Comp. Path. Therap.*, September, 1914. (The species of Trypanosome in this instance is not certain.)

(3). H. Llewelyn Jones : “The Treatment of Trypanosomiasis in Cattle caused by the *Trypanosoma pecorum*.”—*Jl. Comp. Path. Therap.*, June, 1915.

and there was no subsequent reason to believe that "fly" occurs in the vicinity. Many cattle are used on the roads in and out of Gatooma, and if fly occurred the fact could not remain hidden.

III. *Chicago Mine*. S. bank of Msweswe River and about 5 miles E. of railway line. Season 1909-10.

Thirty-six oxen had been at work near the mine for two years, drawing crushing material from a shaft about a mile from the mine. The only time when any of them were away was when four oxen drew a Scotch cart to Gatooma and back about a month before Christmas 1909. The first case was noticed in March 1910 (diagnosed by Bevan). At the time of my visit, 6th April, five cattle had died and at least ten more were "struck." *S. calcitrans* and *Lyperosia* sp. were extremely numerous about the cattle. The writer could find no sign of tsetse in four days, and there has been no subsequent reason to believe that fly occurs at this spot. Cattle have been working on other mines near by for years, but early in 1909 fly-struck cattle were brought to the Lydia Mine, which is only a short distance across the river from the Chicago, and may have initiated the outbreak. The nearest known fly belt is 12-15 miles distant in a straight line to the north.

IV. *M.'s swine*. Farm on N. bank of Umfuli River, on E. side of and adjacent to railway line. Visited on 15th November 1911.

A number of sows had been on the farm for two years. The first death occurred on 15th October 1911, and fifteen had died up to time of the visit, as well as one boar. A large number of young pigs on the farm were all healthy, and a number of cattle there also remained unaffected. *Tabanus taeniola* was very abundant on the cattle at the time of the visit, but did not pester the swine much. *S. calcitrans* was abundant on the swine. This farm is about 10 miles from any part in which one would expect to see tsetse, but the fly was at that time probably carried occasionally close to Hartley, which is about 3 miles distant from the farm. The immunity of the cattle, apart from other facts, practically proves that something other than tsetse was responsible for the spread of the disease amongst the pigs.

(N.B.—Bevan is doubtful as to the trypanosome in the swine being identical with that affecting cattle in the district, but states that morphologically it belongs to the *T. pecorum* group.)

V. *S.'s & G.'s swine*. Adjacent farms on the Umfuli River. S.'s farm is also adjacent to M.'s. Date of visit, 29th January 1916.

Of S.'s swine, three pigs were bought from M. and had remained on the farm since January 1914. On 18th December 1915, 32 sows arrived from East London. A sow from East London died on 15th November 1915, and a second on the 27th, both being heavy in young. On 21st December, 40 pigs arrived from East London (35 sows and 5 boars). To that date, 19 heavy sows and 1 boar had died and two more died during the writer's visit, whilst several young pigs showed symptoms of being "struck." Other pigs died subsequently. Cattle ranged on the farm over the same ground as the swine and all remained healthy. *Tabanus fuscipes* and *Haematopota* sp. were and had been very troublesome to the pigs since the commencement of the rains. *S. calcitrans* was moderately abundant, and the pigs were, of course, much infested with lice (*Haematopinus*).

G.'s pigs were obtained from S. and were exposed to similar conditions, and the outbreak took a similar course. Cattle also remained healthy on this farm.*

VI. M.'s Cattle. Sikombella River, Sebungwe District.

In this outbreak the sequence of events is so clearly defined and the distance of the farm from any fly belt so great that it constitutes in itself a definite proof of the transmission of this form of trypanosomiasis in the absence of *Glossina*. The situation of the farm in relation to the fly belts in the district is shown in the accompanying map (Map II). The outbreak occurred in the 1915-16 season and the history of the affected cattle is given by the owner as follows:—

“In September 1915, four spans of oxen were taken to Sileya's kraal and were employed in transport work between that kraal and Sikombella until 17th December. During October eight of these were taken by a Dutchman into the fly belt on the Sassame River—it may have been the Ensengwe River fly belt in the vicinity of the Sabala River (Bandala's kraal)—and on and off after that were in contact with the remainder of the four spans until 17th December.† After this they were running not only with the remainder of the four spans, but with all the cattle on Sikombella farm; the eight infected oxen were all dead by the end of December, one having died with the first rain at Sileya's on or about 15th November. At the middle of February some twenty head showed sick, but the true cause was not suspected at that time. About 25th February a team of healthy-looking oxen, made up of 11 oxen which had been to Sileya's and 5 young oxen which had not previously left the farm, were inspanned and sent to Gokwe with a load in company with another team of 16, which had been to Sileya's and looked fit; two of these died on the road up, including one of the young oxen, and some six others became sick, including three of the young animals (these three subsequently recovered and are now working‡) I now removed all sick animals to a camp about a mile away, but from time to time I had to keep adding an animal which showed sick amongst the healthy herd. Towards the end of March two *old cows* and my bull (none of which had left the farm) became sick; the two cows quickly died, one leaving a very young calf, which is alive to-day; the bull has entirely recovered since. From the end of February the infected cattle were dying at the rate of two or three a week for two months, after which the death rate would be about one a fortnight until the end of September; some 12 head of infected cattle remaining at that date have recovered and are now working. Some 36 head have died, including the 8 fly-struck animals; all these showed typical fly sickness. With the exception of the eight oxen taken into the fly belt, none of my oxen have ever been in the vicinity of a fly belt, having only travelled the main road between Sileya's kraal and Queque; also the main road between Sikombella Farm and Pondo Mine (years ago)—Mr. Luxat's.”

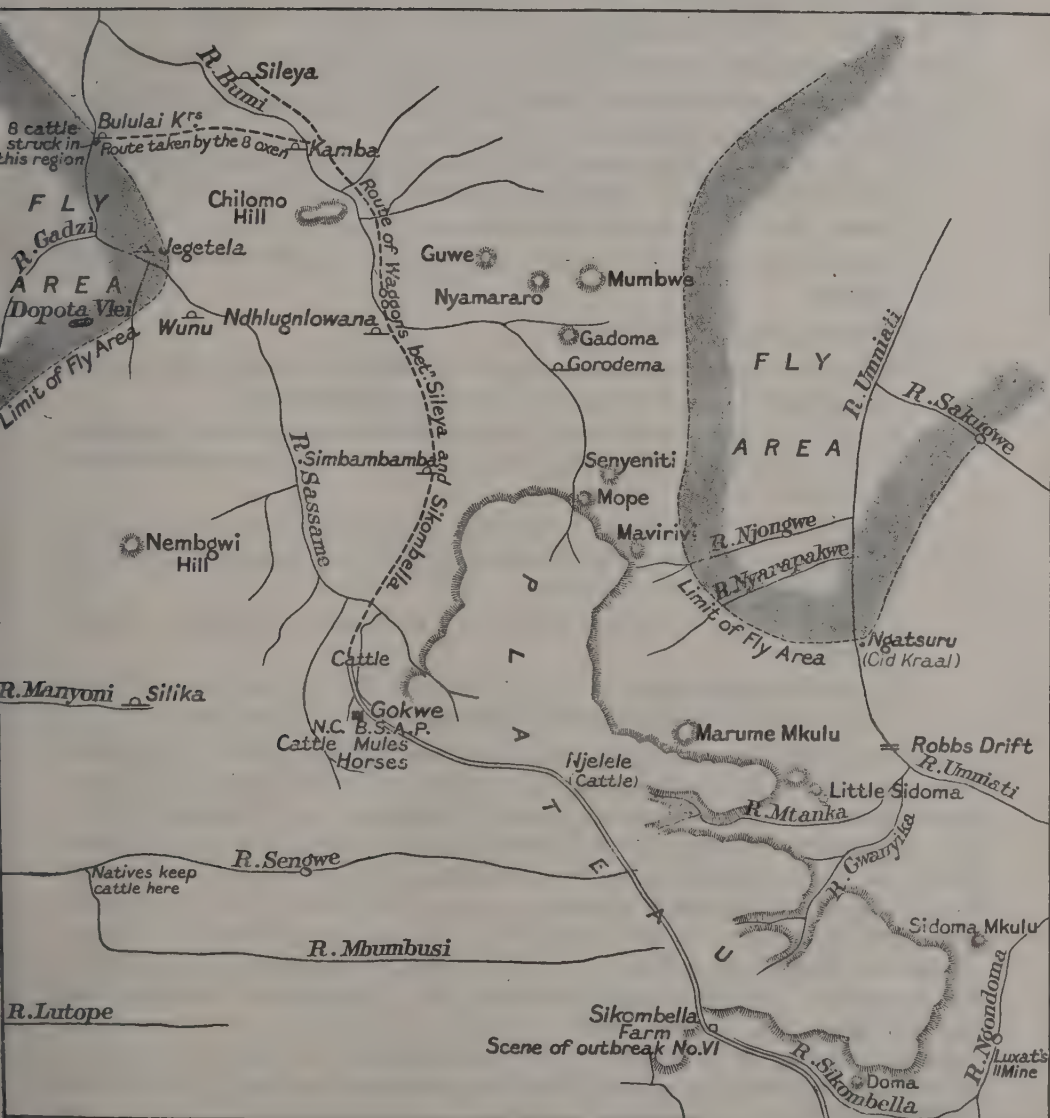
Cattle had been living in a healthy condition on this farm and near by for years. The writer visited the locality in August 1916, and after exploring the vicinity for three days on the possibility of fly having “come down” to the farm from the belt

* The location of the preceding five outbreaks is indicated on Map I.

† The oxen returned with the waggons from Sileya's kraal to the Sikombella River in December.

‡ The disease was diagnosed by Bevan from smears taken from these three oxen.

MAP II.



Sketch-map showing the position of the fly areas in the Sebungwe District.

to the north, travelled down the Gwanyika River and down the Umniati to ascertain if any movement of the fly had taken place. No fly were encountered until the spot was reached where its southern limit on the Umniati River was marked in 1914. From the Umniati the return journey to Gokwe was made via the Mtanka River, all the country traversed, as on previous occasions, proving free from fly.

The following points are noteworthy in connection with the cases cited above :—

- (1). In all cases the outbreak attained its height during the spring and summer months (October–April).
- (2). In all cases, in connection with which sufficient time has elapsed for such observation, there has been no recrudescence of the disease in the following season, although susceptible animals have still been kept in the same locality.*
- (3). In all cases infection occurred only amongst animals that were herded together.

From the foregoing it appears probable :—

- (a) that the transmitting agent or agents are abundant in the spring and summer and disappear or decrease greatly in number in the winter ;
- (b) that the disease is not readily transmissible under Southern Rhodesian conditions by these agents from chronic cases that live over until the rains or recover ;
- (c) that the agents concerned in this method of transmission are not capable of perpetuating the disease indefinitely, or are only capable of doing so under exceptional circumstances ;
- (d) that the method of transmission is of a mechanical and not of a cyclical nature ;
- (e) that the segregation of infected animals (on showing temperature) would in the absence of tsetse effectively check the spread of the disease.

Allowing for the moment that the deduction given tentatively under (a) is correct, very few species of blood-sucking Diptera are eliminated by this statement, as, apart from *Glossina morsitans* and certain species of *Hippobosca*, all the common blood-sucking flies are very much scarcer in winter than in summer. Moreover, observations as to the prevalence of possible transmitting agents in the locality of the outbreaks furnishes a number of different species as likely subjects for experiment. The most probable agents are included in the following :—*Tabanus fuscipes*, *T. taeniola*, *Haematopota pertinens*, *Haematopota* spp., *Stomoxys calcitrans*, *Lyperosia* and mosquitos. Of these it must be admitted that *S. calcitrans* and mosquitos are the only agents that are everywhere abundant throughout the season over which infection extends. It is, however, by no means necessary to infer that the power of mechanical transmission is confined to one species or to one family ; and in view of Mitzmain's failure to associate *S. calcitrans* with the transmission of surra in the Philippines, it appears unlikely that this species is solely responsible in regard to the present disease. The whole matter calls for careful experiment and investigation.

* This is, of course, contrary to the experience in Barotseland and Portuguese East Africa

With regard to (b) and (c), these deductions are fully borne out by experience in this territory where fly-struck cattle have been freely moved into fly-free areas in the past. These movements have not resulted in *establishing* trypanosomiasis in any area away from the fly belts. If this method of transmission can continue freely and indefinitely, it is difficult to understand why the disease has not by this time become generally spread throughout the continent.

In no instance as yet recorded in Southern Rhodesia, however, can *Glossina* be definitely disassociated from the *inception* of the outbreak. The main point is, that the herding of "fly-struck" cases with healthy animals is a practice attended with danger, especially in the spring and summer months.

A NEW SPECIES OF *PARAPHELINUS*, PERK., FROM BRITISH GUIANA,
WITH A DISCUSSION OF THE GENUS AND THE ALLIED
APHELINUS, DALM.

By JAMES WATERSTON, B.D., B.Sc.,
Imperial Bureau of Entomology, London.

During the past summer (1916) Mr. C. B. Williams has, on behalf of the Department of Agriculture, Trinidad, been engaged in investigating the natural enemies of *Tomaspis* and its allies, in the hopes of finding some effective means of controlling the froghopper, *Tomaspis saccharina*, Dist., which in recent years has caused considerable damage to the sugar plantations of Trinidad. With this object Mr. Williams has made collections of minute parasitic Hymenoptera in the Island and the adjacent mainland of British Guiana, and this material has from time to time been forwarded to me for study. Mr. Williams has from the first been fully alive to the importance of securing any specimens of the egg-destroying *Paraphelinus*, Perk., and I am glad to find species of this interesting genus in the gatherings from both Trinidad and British Guiana. The literature dealing with *Paraphelinus* is scattered and perhaps inaccessible to those to whom it is most likely to prove serviceable. I have therefore, in some introductory notes, recapitulated the main facts in the life-history and host attachment and added a bibliography to the present paper.

As an economic insect *Paraphelinus* owes its importance to the fact that while most APHELININÆ attack Aphids, Coccids, and Aleurodids, this genus destroys the eggs of *Xiphidium* and *Tomaspis*. Although the genus is of comparatively recent erection, it is likely, as Dr. Perkins pointed out in his original description, that *Agonioneurus locustarum*, Giraud, bred from the eggs of a grasshopper, *Xiphidium fuscum*, is really a *Paraphelinus*. *P. xiphidii*, Perkins, is an efficient controller (Swezey, 2, 4) of *Xiphidium varipenne*, Swez. The parasite was first observed in March, 1905, in the grounds of the Hawaiian Sugar Planters Association's Experiment Station, Honolulu, where it had almost certainly been introduced.

The eggs of the *Xiphidium* are laid in clusters just beneath the leaf-sheath of the sugar-cane, where they are attacked by the parasite; 7-14 examples of *Paraphelinus* may emerge from a single egg and occasionally the whole cluster of eggs (2-15) is affected. Like many species of which several imagines emerge from a single host, all the individuals in a brood of *P. xiphidii* use the same hole of emergence, which is gnawed by the first to hatch out. The aperture is circular, and when the host egg is closely pressed against the leaf-sheath, the latter as well as the egg-shell may be gnawed through. If the *Xiphidium* egg is examined in balsam after the parasites have emerged, the empty pupal envelopes of the *Paraphelinus* may be seen, together with numerous darker granules within the shell. These granules are the accumulated foecal matter which is discharged by the insect shortly after emergence. Parasitised eggs are bluish-black in colour. The life-cycle of *Paraphelinus* varies from 20-31 days, that of the host being three months; the parasite is thus placed at a distinct advantage, and shortly after it was first noted, proof of its beneficial work was given by the rapid disappearance of *Xiphidium* in some districts.

a | About three years later Swezey (4) recorded a disconcerting departure from the usual habit of *Paraphelinus*. In February 1908, *P. xiphidii* was bred as a hyperparasite from cocoons of a Dryinid, *Haplogonotopus*, Perk.* Experiment showed that *Paraphelinus* reared from the Dryinid readily attacked *Xiphidium* eggs and the resulting imagines quite as freely reverted back to *Haplogonotopus*, attacking the larva just before it pupated. Whether the host was an egg or larva the number of *Paraphelinus* was the same, viz., 12 or 13 commonly.

Apparently *P. xiphidii* is a vigorous parasite, attacking whatever pabulum most conveniently offers itself; and the unfortunate feature of this particular case of hyperparasitism lies in the fact that it was desirable to protect the Dryinid because it destroyed leaf-hoppers. *Xiphidium varipenne* itself is partly a noxious insect, in so far as it attacks tender shoots, flower stamens, etc., and partly useful as a devourer of Aphids.

The material which I have had before me is as follows:—

- (a) A single female—"St. Clair, Trinidad; 12.iv.16; swept from grass" (C. B. Williams), which I have determined as *P. tomaspidis*, How. (see notes p. 56);
- (b) two lots of a distinct new species from British Guiana: (i) Issororo, N.W. Dist., 6.vii.1916, Lot 7, "Emerged from base of grass, *Imperata caudata*, containing *Tomaspis* ? *carmodyi*" (C. B. Williams), 2 ♂♂, 8 ♀♀; (ii) ib. et id., Lot 8, during July 1916, 8 ♂♂, 26 ♀♀;
- (c) a slide containing a "parasitised egg of *Xiphidium* ♂ and 6 ♀♀ of *Paraphelinus*, Perkins"—Lahaina, Maui, 28. ix. 1905 (O. H. Swezey); possibly the seven examples referred to by Swezey (2, p. 215). This was generously placed at my disposal by Dr. Perkins to treat as might seem best. The seven examples have been remounted after careful potashing, the male and three females being partly or completely dissected. These preparations with others from Mr. Williams' material are deposited in the British Museum.

Only the most careful manipulation will produce satisfactory preparations of *Paraphelinus*. The wings may be detached from either dried or spirit material and mounted in the way already suggested (*Bull. Ent. Res.* vii, p. 231-2); but after potash and acetic acid, transference to oil should be gradually attempted. Three or four graduated layers from oil to absolute alcohol in a narrow 1 inch tube are not too many when dealing with such delicate organisms; the actual transference to absolute should be effected as quickly as possible, for even a momentary pause will permit the acid to evaporate and the preparation will be ruined. The object of having the specimen charged with acetic acid when passed into absolute is to regulate transfusion and to prevent collapse.

The slide of *P. xiphidii* was treated as follows:—The hard balsam at the edge having been removed, a little xylol was run round the cover slip; when the xylol had acted on the balsam for a short time two needle points were inserted a little apart and the cover broken by pressure between. In this way the cover was gradually chipped off without at any time bringing pressure to bear upon the brittle mounts.

* "*H. vilnensis*. . . . No repetition of this hyperparasitism has since come to my notice."—O. H. SWEZEY, in litt., Dec. 1916.

It was interesting to find that after ten years the balsam had hardened only for a short distance from the edge. After being detached the specimens were thoroughly soaked in xylol and transferred to spirit, after which they were manipulated in the usual way.

External Morphology of Paraphelinus, Perk.

In the following account of *Paraphelinus* some notes of more than generic application have probably been included. The value of particular characters, whether tribal, generic, or specific, is at present very imperfectly understood in the Aphelinines. In particular, too little attention has been paid (*a*) to the clypeus and mouth-parts, especially the labrum, (*b*) to the sternal apophyses, and (*c*) to the general chaetotaxy; and in respect of these and some other features, I have tried to place the genus on a sounder basis.

Although the elongate facies, the antennae, and the head, distinguish the group at a glance, it is perhaps worth noting that one of its most striking features—the course and ending of the genal keel—might quite easily arise by an exaggeration of conditions obtaining in other allied genera. In the not very closely related *Coccophagus* group, *e.g.*, in some quite thin-headed forms, the keel is well forward, though the genae are normal. A little further shifting would cause the lower extremity of the keel to fuse with the sides of the clypeus and the condition found in *Paraphelinus* would result. Similarly the antennae with their distinctive “elbow” and terminal “horn” might result from an inconsiderable modification of the antenna in *Aphelinus* itself. The cumulative effect of such slight differences however is decided, and (apart from their host attachment) the species showing them form a compact genus.

The two known males are easily separated, but the females are extremely uniform, presenting differences of a rather critical nature. In discussing the antennae I state that 6 (7) joints are present; *i.e.*, of these six are obvious, but the first funicular has, I believe, the lamina or disc of the ring joint fused to it basally. With Perkins and Howard I assign the penultimate joint to the *funicle* and consider the last joint to be a solid club; Girault treats the penultimate as the first of a two-jointed club. In its natural position (seen best in a specimen mounted without pressure in a cell or under a supported cover-slip) the antennal “beak” curves gently outwards and the sense-organ appears in its normal position on the inner aspect. When, however, the antenna is mounted separately, the weight of the cover-slip, without distorting the general shape, brings the surfaces into the same or parallel planes, when the tip of the antenna appears to be decurved, and the sense-organ is dorsal. All the figures of the antenna have been drawn from this position. Besides the usual linear sensoria the club bears two peculiar organs each with a central stouter bristle (?); focussing down a little, these organs seem circular, but when the central bristle is distinct the surrounding rim is vaguer. The head is particularly difficult to examine, owing to the inequalities of surface it presents, and to its liability to collapse during the process of mounting. The chaetotaxy and shape of the clypeus may be made out in shrunken specimens, but notes on the proportions are worthless unless the head is naturally swollen.

In the thorax noteworthy features are the slight advance of the axillae, structure of the sternopleurae, etc. One peculiar abnormality of the dorsal chaetotaxy

deserves mention, viz., the very frequent failure of the second anterior medio-dorsal bristle on the *left* side of the mid lobe. The lateral ridges of the propodeon are really folds more or less internally strengthened. If preparations of *Paraphelinus* are made too quickly, the thin mid-dorsal region of the thorax is apt to collapse longitudinally, forming a more or less distinct furrow. This appearance can very easily be produced by plunging a specimen into oil after incomplete dehydration. Whether in life this line of weakness in the chitin has a sulcate appearance or not is uncertain, but I think the point worth mention, as Girault (6, p. 74) says of *Paraphelinus australiensis*, "There is a narrow median grooved line down the thorax." *P. speciosissimus*, Gir., is much more isolated, and it was hardly advisable to reconstruct the genus, as Mr. Girault (5) has done, from such a form. In four of the five described species the forewings are hyaline or faintly tinted, not conspicuously banded; the general coloration pale, *not* black and yellow; and the eyes hairy, *not* bare. Later Mr. Girault (9, p. 180) mistakenly, as it seems to me, sank *Paraphelinus*: "The forms named *Paraphelinus*, Perkins, intergrade with the forms of *Aphelinus*, Dalman, as the Australian species show, so that obviously there are not two genera represented by them. *Paraphelinus* must therefore fall as a true synonym of *Aphelinus*."

In *Aphelinus* (sens. str.), which preys upon various Aphids, the head is short and thin, normal, lenticular, with large eyes, behind which there is no temporal development. The occiput is sharply margined where it joins the vertex. The genal keel passes ventrally outside and behind the toruli; the clypeus is practically in the same plane as the frons, and its edge is straight. The mid lobe of the mesonotum is densely covered with short sharp bristles, the parapsides, which are deeply invaded by the axillae, bear 4 bristles. There are short, stout bristles on the metapleurae. The fore wings are triangular and the hind wings broad, with a short fringe; the abdominal tergites decrease in length posteriorly, and the ovipositor and its sheath are short. In all these characters *Aphelinus*, Dalm., offers a precise contrast to *Paraphelinus*, Perk.; and there are other differences, less obvious but equally important; e.g., in *Aphelinus* instead of a backward-sweeping parabolic incassation the pleurae show a short nearly verticle anterior rib. The prepectora are medianly fused and, in conjunction, band- or collar-like, reminding one of the genus *Coccophagus*, to which *Aphelinus* also approaches in its mandibles (cf. also the mesonotum). The genotype of *Aphelinus* is *A. abdominalis*, Dalm. (Svensk. Vet.-Akad. Handl., xli, p. 181, t. 8, f. 55, 56, 1820), of which *A. basalis*, Westw. (Ann. Nat. Hist., vi, p. 122, 1833) is, I believe, correctly regarded as a synonym. The foregoing remarks on the generic characters are based on an examination of two very old specimens of *A. basalis* in the British Museum Collection; one bears the data—"stood under this name in old B. M. Coll.—C. Waterhouse"; the other is labelled "*basalis*" in the handwriting of F. Walker, to whom the determination of both examples is due. The first is now completely dissected on two slides, the second mounted whole, except that the fore wings are under a separate cover-slip.

But while *Paraphelinus* is distinct from *Aphelinus*, it is closely approached by the small yellow-bodied group (at present placed in *Aphelinus*) which attack Coccids. Whether Perkins' genus should include the latter or not I cannot say; it is one of the Coccid-destroyers, *A. diaspidis*, How. (Ann. Rept. Dept. Agric., p. 355, 1880),

which Howard has figured as representative of Dalman's genus (U. S. Rept. Agric. Tech. Series, No. 1, p. 23, fig. 7, 1895).

Genus *PARAPHELINUS*, Perk.

♀ *Head* (fig. 1, *a*, *b*, *c*): In profile, long antero-posteriorly, the vertex, which hardly rises above the level of the eyes, being flattened, like the upper frons. Face inflated, widening ventrally and curving in sharply above the perpendicular clypeus; genal keel short; temples and genae swollen, the latter widening ventrally. Eye subtriangular, occupying about two-thirds of the depth, both upper angles broadly,

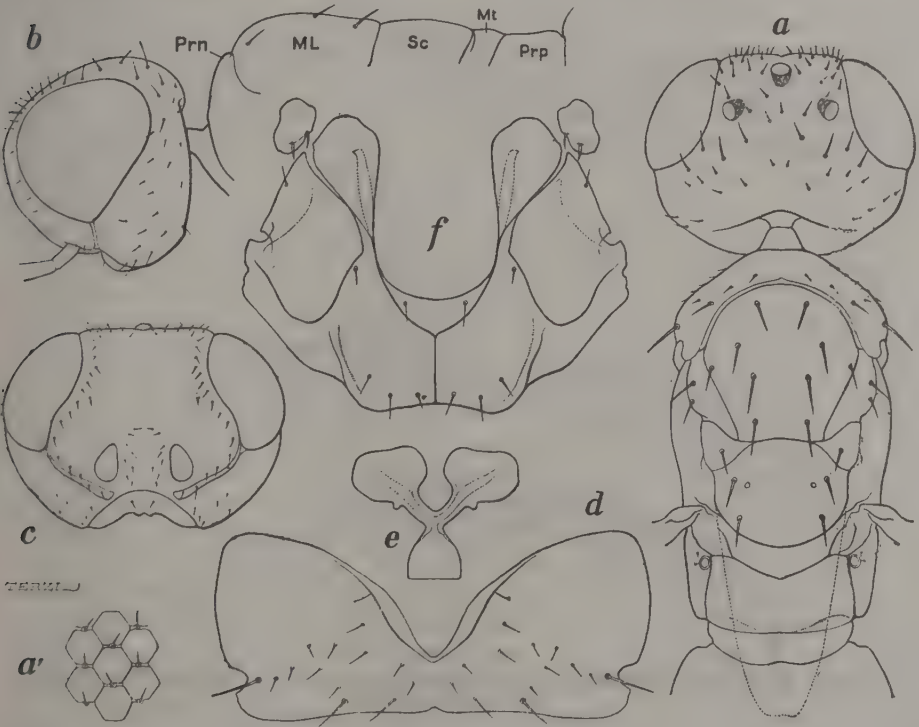


Fig. 1. *Paraphelinus xiphidii*, Perk., ♀: (*a*) head, thorax, and propodeon; (*b*) head, etc., in profile. *Paraphelinus perkinsi*, sp. n., ♀: (*c*) head, front view; (*d*) pronotum; (*e*) presternal apophysis; (*f*) mesosternopleurae—all flattened.

the lower angle hardly at all, rounded, set with numerous bristles arranged in straight rows. From above, the vertex is both broad and long, the orbits nearly parallel, but slightly divergent posteriorly; ocelli in a wide-angled triangle, the lateral pair about two diameters from the edge; supra-occipital edge broadly rounded; temples swollen distinctly backwards. From in front, the face proper contracts ventrally, the most remarkable feature of the head here being the running of the broad genal keel forward below the toruli to the upper angles of the clypeus, and the shortening

of the mouth-edge. The swollen out genae are carried forward beneath the toruli also, and are largely visible from in front. In the middle of the clypeus is a minute notch flanked on each side by a more or less distinct short lobe or tooth. The toruli are elongate, sub-triangular, broadest ventrally, with their adjacent sides sub-parallel.

Antennae (fig. 2), 6 (7)-jointed; scape, pedicel (ring-joint), three in funicle, club solid. Bulla long, apex of pedicel oblique, funicular joints gradually expanded. Second funicular joint set at an angle to the oblique apical dorsal surface of the first; second and third funicular in the same straight line, but the suture between them is more or less oblique. Third joint with one sensorium; club wider than last funicular, with several sensoria, and ending in a short outwardly curved beak. On

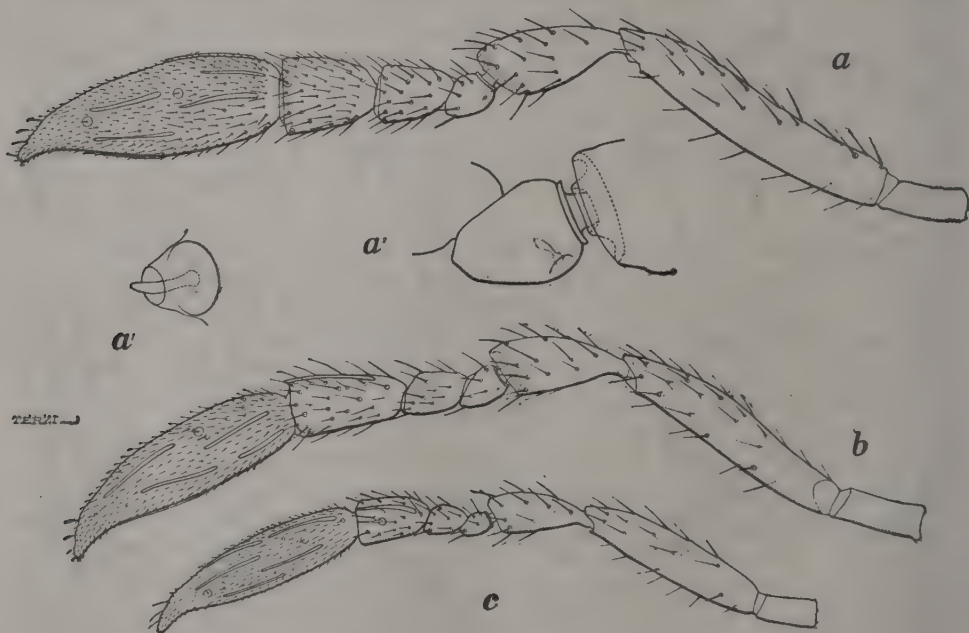


Fig. 2. Antennae of females of: (a) *Paraphelinus perkinsi*; (b) *P. xiphidii*; and (c) *P. tomaspidis*.

the inner apical aspect is a small sense-organ consisting of 4-5 sensory hyaline bristles, stouter than the elements of the general chaetotaxy of the antenna, standing above definite passages through the integument of the club.

Mouth-parts: Labrum triangular, apically rounded, with 2 central preapical bristles. Mandibles broad basally (8:7), tridentate. Trophi nearly circular; cardo small and narrow, stipes swollen and broad; maxillary palpus with the second joint sometimes presenting a false appearance of being divided in two; labial palpus longer than either joint of the maxillary; ligula with two median setigerous cells.

Thorax (fig. 1, a, b, d, e, f) flat dorsally; including the propodeon, half as long again as broad, widest at the level of the fore wings. The pleurae are very little

convergent towards the rounded, nearly rectangular, postero-lateral angles of the propodeon. The integument weakly chitinated and smooth or faintly patterned along a narrow middle line; the pattern beyond the middle line more raised towards the sides and the cells generally longer than broad. Pronotum descending, developed into two weakly connected triangular sclerites; when flattened, deeply emarginate anteriorly, straight posteriorly, the hind and lateral margins meeting in rather over a rounded right-angle, before which is the deep semicircular spiracular emargination. The longest and stoutest bristle is placed above the spiracle and there is always another fairly stout bristle before the edge half-way from the postero-lateral angle to the middle. Prosternum bare, rectangular, truncate posteriorly. Episternite large, with a minute bristle anteriorly and half a dozen on the anterior articulating projection. Mesonotum distinctly longer than the scutellum, mid-lobe large, the width at the anterior extreme of the parapsidal furrows about equal to the length; 10 stout coloured bristles in two widely separated rows (4:4) about the mid line and one inside each parapsidal furrow anteriorly. Side lobes narrow; two bristles on outer edge above the tegula, which also bears two bristles. The suture between the mid lobe and scutellum broad, a little curved antero-laterally where the small axillae (one bristle) shortly invade the rather narrow parapsides. Scutellum with 4 bristles (2:2), wider apart than those on the mid lobe. At the level of the anterior pair but a little nearer the mid line are a pair of clear pustules. Mesophragma long and narrow, reaching back to below the hind margin of the first abdominal segment. Metanotum and propodeon not carinate, but as both, especially the second, are declivous, about the mid line the latter shows up in a more or less distinct ridge. Metanotum band-like (the smooth lateral hollows small and shallow), present mainly as a broad short reticulated post-scutellum, which is widely angled over the propodeon. The latter as a rule nearly smooth, except medianly; two posteriorly slightly divergent faint lateral folds, so far apart as to be nearly in line with the sides of the abdomen. Beyond each fold there is a narrow triangular area with a short anterior sulcus; at the inner anterior angle lies the broadly oval moderate sized spiracle. Sternopleurae: sternum broader than long, pattern various, but rather large, very finely raised; two minute widely-spaced bristles on anterior edge, and 4 (one near each postero-lateral angle, and one on each side of the mid line) near posterior edge. Between sternum and pleura is a weakly defined edge, obliterated posteriorly (without internal support) and represented by a slight crease in flattened-out preparations. At the anterior end of this crease, and confluent with it for nearly half its length superiorly, there is a strong parabolic internal rib which, beginning at the antero-lateral sternal angle, sweeps backwards, enclosing about four-fifths of the pleural surface, and ends superiorly at the insertion of the forewing. The area thus enclosed is a little more prominent than the posterior (epimeral) region, which is delimited ventrally by a ridge, sloped from above the mid coxa diagonally towards the upper anterior pleural angle and fading out (at about one-fourth) in front of the parabolic rib already described. The pleural surface bears one minute bristle antero-ventrally. The episternite is indicated only by an internal chitinated suture. Prepectus large, antero-posteriorly striate, the cross reticulation nearly obsolete. The internal chitinous rib very near the hind edge. The metapleurae are absolutely bare.

Wings elongate, at least three times as long as broad, subspatulate in shape. Neuration reaching to one-half or just beyond, and very little bent at the junction of the marginal and submarginal. Submarginal cell narrow, with one minute bristle on the *upper* surface at one-third from the radix, and 2-4 apically. Submarginal vein with four short stiff bristles, one stronger on the marginal before that vein reaches the costa, 6-8 major bristles fringing marginal and postmarginal combined, while dorsally these veins bear 9-12 short appressed bristles. One bristle on radius, which is acutely inclined towards the costa. Basally the wing is narrowed, showing a few bristles below the submarginal. Across the wing, at the junction of the marginal and submarginal, is a sloped indistinct bare area, and another broad "hairless line," much better defined and roughly parallel to the first, crosses the wing from the end of the radius. This second track does not reach the posterior edge, before which one or two rows of the usual discal ciliation intervene. It is similarly cut off from the small clear spot outside the radius,

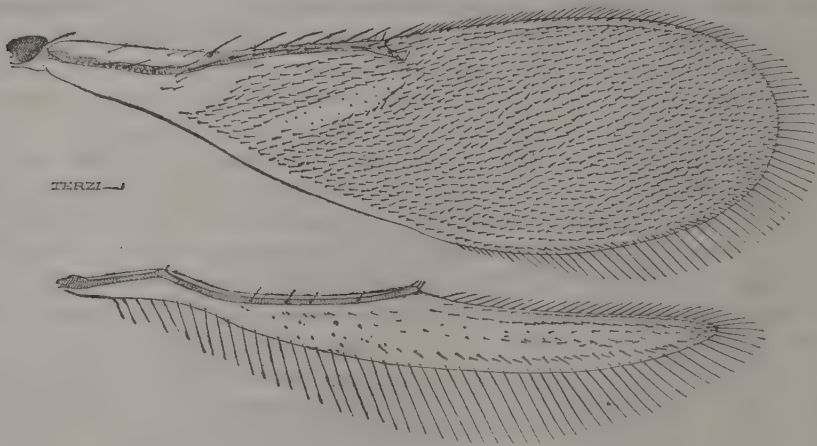


Fig. 3. *Paraphelinus xiphidii*, wings.

generally by one, sometimes by several, rows of bristles. The clear path shows scattered black dots, which are not the bases of broken-off bristles, but under an oil immersion are seen to be excessively minute prickles (rudimentary bristles?) set in the wing membrane. Beyond the bare track the discal ciliation is regular and dense, coming evenly up to the margin everywhere, but tending to form an isolated isoclinal row parallel to the costa on the apical half. Marginal cilia on costa very short and dense, sparser and longer apically, longest on the distal two-thirds of the hind margin and shortened again after the frenulum. *Hind wings* not much shorter than the fore wings, with no submarginal cell, narrowed basally and very elongate (up to eight times as long as broad). Posterior fringe long, equal to the extreme breadth (at the hooks). Costal fringe moderate. There is a row of minute bristles along the costa and a distinct isoclinal row subcostal in position. Discal ciliation otherwise sparse, varying specifically.

Legs. Fore legs: femur with no strong ventral bristles, except a (coloured) longer anterior one and a shorter (hyaline) posterior one, subapical in position;

tibia with the superior apical angle narrowed, chitinated, the apical comb hardly developed, with 2-3 spines. Mid legs: tibiae long, spur long and thin. Hind legs: coxae elongate, flat, oval; tibiae elongate, exceeding those of mid legs, spur short and not half the first tarsal joint. Tarsal proportions: in the fore legs the first and second tarsal joints are subequal (9:8), whilst in the mid and hind legs the first joint is much longer than the second (4:3); joints 3 and 5 are subequal in all the tarsi, 4 being a little shorter.

Abdomen elongate, acuminate, seen from above at least twice as long as broad, from the petiole to the base of the ovipositor sheath. Dorsal surface smooth, broadly in the middle, except for a narrow scaly reticulate band across the middle of the first tergite. Towards the side this band becomes normally reticulate, while at the extreme sides and on the overlaps of all the tergites the cells are drawn out antero-posteriorly. Posterior tergal edges straight, on 5 and 6 a little convex posteriorly. Tergites 1-5 equal, 6-7 longer. (The first tergite being anteriorly concave appears shorter, but at the sides it is even longer than its successors.) Sternites 1 and 5 are subequal and long, 2-4 much shorter and subequal.

Normal abdominal chaetotaxy:—

	I.	II.	III.	IV.	V.	VI.	VII.
Tergites ..	2, 2	2, 2	2, 2	3, 1, 3	8	2, 2	4, 4
Sternites ..	0	1, 1	1, 1	2, 2	6, 6	—	—

The bristles on tergites 1-3 are wide apart, one at the edge closely accompanied by the second. On tergite 5 the eight bristles form a continuous row with one in front and sometimes one behind at the sides. There are a few (3-5) minute post-spiracular bristles besides the longer transverse ones on tergite 6. The setigerous process on tergite 7 bears four bristles, one shorter. This tergite extends narrowly backwards above the base of the ovipositor sheath, but the bristles borne here are probably of specific value. On the fifth sternite the bristles are arranged 1, 2 and 3 on each side of the mid-line. The free portion of the sheath is rather long, and projects distinctly with the ovipositor.

Male similar to female. The antennal formula the same, with the scape flattened more or less. Wings shorter and broader. Fore legs a little stouter; second tarsal joint relatively shorter than in the female.

List of Species described in the Genus Paraphelinus, Perk., with Data of Host Attachment, original Collector, and Location of Type.

1. *P. xiphidii*, Perk. (1906) (l.c., p. 264, pl. xx, f. 6). From eggs of *Xiphidium varipenne*, Swez.; Hawaii (O. H. Swezey).

Type (female) in Mus. of Haw. Sug. Pl. Assn., Honolulu, Hawaii.

2. *P. speciosissimus*, Gir. (1911) (l.c., p. 181). Host unknown; Urbana, Illinois (A. A. Girault).

Type (female) in U. S. N. M., No. 14,122, Washington, D.C.

3. *P. australiensis*, Gir. (1913) (l.c., p. 74). Host unknown; Nelson, Queensland (A. A. Girault).

Type (female) in Queensland Museum, No. Hy. 1712, Brisbane.

4. *P. tomaspidis*, How. (1914) (l.c., p. 82). From eggs of *Tomaspis varia*; Trinidad (P. L. Guppy)

Type (female) in U. S. N. M., No. 18,321, Washington, D.C.

5. *P. perkinsi*, sp. n. From *Tomaspis* ? *carmodyi*; British Guiana (C. B. Williams).

Type (female) in British Museum, London.

To the above should possibly be added *Agonioneurus locustarum*, Giraud (1), bred from eggs of *Xiphidium fuscum* in galls of *Lipara* spp. on *Arundo phragmitis* (Europe).

Since sinking *Paraphelinus*, Perkins, Mr. Girault has with extreme brevity described the undermentioned yellow or pale-coloured species of *Aphelinus* from Australia. In 1913 (9) the following:—*haeckeli*, *grotiusi*,* *darwinii*, *minutissimus*, *newtoni*; in 1915 (11) he added *miltoni** and *ruskini*. Of these the two asterisked species are probably referable to *Paraphelinus*, but only a re-examination of the types, which are deposited in the Queensland Museum, Brisbane, can enable one to place them exactly.

No remarks have been offered in the notes just given on the general coloration of *Paraphelinus*, but it is probable that the genus when more extensively collected and described will be found to include only pale forms like *perkinsi*, *xiphidii*, and *tomaspidis*. Detailed colour notes have been given only for the first of these. The infuscations of the abdomen, etc., are exceedingly faint, and when the body contents have been cleared away by potash the whole insect is perfectly transparent. Only in *xiphidii* are the genae distinctly darker; in *tomaspidis* they are faint. The wings in *xiphidii* and *perkinsi* are hyaline, in *tomaspidis* faintly embrowned. The following keys may serve to separate the species:—

Key to the Males of Paraphelinus, Perkins.

First two funicular joints very short and broad, the third elongate, cylindrical, nearly equal to the club, which bears the longest bristles of the antenna

xiphidii, Perk.

First two funicular joints normal, cylindrical, the third normal, two-thirds of the club, which bears the shortest hairs of the antenna

perkinsi, sp. n.

Key to the Females.

- 1 (2). Yellow and black species; forewings with a conspicuous median black band as wide as the marginal and stigmal veins *speciosissimus*, Gir.
- 2 (1). Concolorous, the head and thorax reddish yellow, abdominal tergites at most a little infuscated laterally; wings hyaline or uniformly faintly tinted.
- 3 (4). Deep orange yellow, immaculate; hind wing near tip with about 5 lines of discal cilia *australiensis*, Gir.
- 4 (3). Paler species; genae, metanotum and tergites of abdomen more or less infuscated.
- 5 (6). "Hairless line" of forewings incomplete on anterior half, with anteriorly convergent sides *tomaspidis*, How.
- 6 (5). "Hairless line" crossed at most by one or two lines of discal cilia at level of the radius knob, with sub-parallel sides.

- 7 (8). Club just longer than pedicel, third funicular joint about twice (5 : 3) as long as the second *xiphidii*, Perk.
 8 (7). Club distinctly shorter than pedicel, third funicular not nearly twice (4 : 3) as long as the second *perkinsi*, sp n..

The following notes refer chiefly to the more minute specific differences between the females. It will be noted that the new species is more hirsute than the others. The males are so easily separated by the characters given in the key and figures that minor differences are not now described, but the dimensions of the antenna and wings have been stated. The legs of three of the species are compared in a concluding paragraph.

***Paraphelinus xiphidii*, Perk. (1906).**

♀. *Head*: in profile (fig. 1, *b*) the vertex and upper frons are about four-fifths of the depth; where the frons is swollen out to its greatest extent the length and depth are about equal. On the gena the reticulation is drawn out, and there are 12–15 short scattered bristles up to the insertion of the episternites. From above (fig. 1, *a*) about one-half as long as broad, the proportions across the vertex at the posterior ocelli are 6 : 11, and in front of the anterior ocellus, where the eyes are nearest, 5 : 12; wider than thorax (22 : 19). Reticulation of vertex transverse, more regular anteriorly, three minute bristles in ocellar triangle with 2 (1 : 1) stronger ones between each pair of ocelli, the bristles close to the ocelli. Behind the posterior ocelli the vertex bears six stouter bristles (2, 2, 2), the middle pair in advance of the lateral pairs, and there are also 6–7 minute bristles at each side on the rounded edge above the temples. Between the orbits, a lateral and an anterior ocellus are 4–5 bristles. The frons bears along the orbits (between the keel and the level of the anterior ocellus) about a dozen bristles, the lowermost fine hyaline, 4–5 of the uppermost dark and stouter. Between each upper row of stronger bristles and the mid line are about 9 similar bristles (5, 4). The greater part of the face below is bare and faintly reticulate. Between and above the toruli 6–8 pairs of bristles, one pair above the clypeal edge and 3–4 (single) inside the genal keels.

Antenna (fig. 2, *b*): length, .37 mm.; bulla (3 : 1) over one-third (5 : 14) of the scape. Scape + bulla equal to pedicel + funicle. Pedicel just over half (23 : 42) the scape; 1st funicular (8 : 6), 2nd (12 : 7), 3rd (20 : 10), club (44 : 12). The club distinctly longer than the funicle (11 : 9), equal to (or if carefully measured, just longer than) the scape, and bearing 4–5 long sensoria. The scape with 4 ventral bristles, otherwise like *perkinsi*, except that there are only about a dozen bristles posteriorly.

Thorax: pronotum with the spiracular emargination occupying about two-ninths of the lateral edge; between each stout bristle on the posterior edge and the mid line are two weaker ones, 2–3 minute on each side of the mid line, and 6–8 obliquely across each half. Pattern everywhere distinct, traceable to the mid line. Mesonotum (14 : 15) half as long again as the scutellum (3 : 4). Mid sternal region distinctly separated from prepectus. Sternal pattern very faint but the cells large and sharply outlined when finely focussed.

Propodeon nearly twice as long as the metanotum (11 : 6) which is coarsely transversely reticulate; pattern very faint medianly, more distinct towards the lateral ridges. Spiracle circular, with two minute bristles at the outer edge of the rim.

Wings (fig. 3) about three and a third times as long as broad; length, .7 mm.; breadth, .21 mm. (excluding fringe). Hind wings over eight times as long as broad; length, .6 mm.; breadth, .07 mm. (excluding fringe); longest hairs of fringe as long as, or just exceeding the breadth.

Abdomen twice as long as thorax and propodeon, and nearly thrice as long as broad (8:3). The 7th tergite long and narrow, much longer (10:7) than the preceding (spiracular) tergite. The ovipositor does not exceed the sheath, which projects shortly (one-third the length of the seventh tergite), the free portion of the sheath being about one-half the base. Above the fixed part of the ovipositor sheath there are on

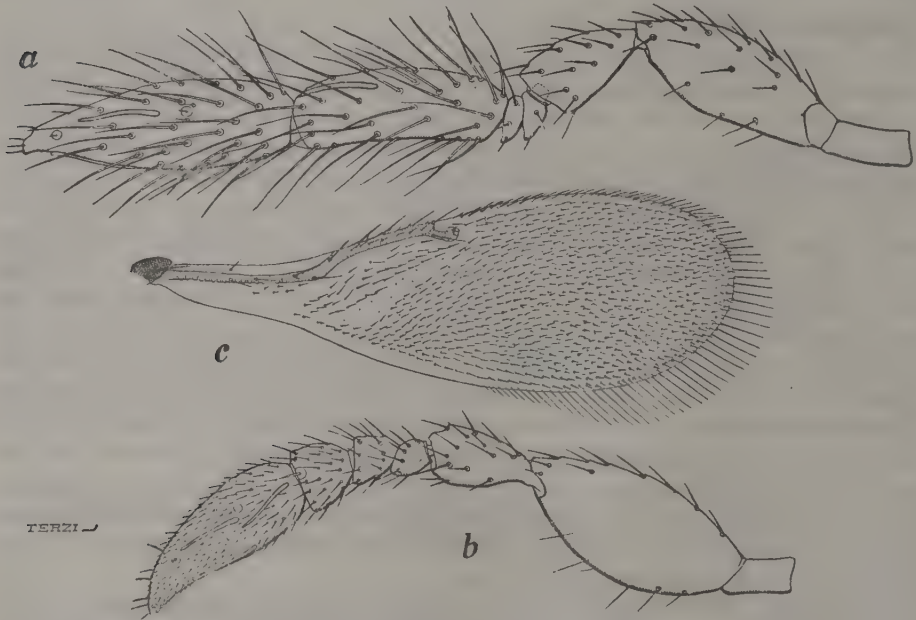


Fig. 4. *Paraphelinus riphidii*, ♂: (a) antenna.
P. perkinsi, ♂: (b) antenna; (c) forewing.

the apical half about 4 longer bristles with 3 above placed below and behind the setigerous process; the free portion of the sheath bears a ventral row of 4-5 longer bristles with as many more (shorter) above and one or two (minute) at the apex.

Length, about 1 mm.; *alar* expanse, 1.6 mm.

♂.—Antenna (fig. 4, a): length, .37 mm. Forewings: length, .64 mm.; breadth, .2 mm. Hindwings: length, .54 mm.; breadth, .07 mm.

***Paraphelinus perkinsi*, sp. nov.**

Vertex, upper two-thirds of frons, eyes, and entire dorsal thoracic surface, pale rusty yellow; the dark inner chitinous socket of the eye shining through; ocelli, tips of mandibles, and ventral half of orbits (very narrowly) dark reddish brown; genae infuscated a little. Wings faintly tinted, veins hardly darker than the membrane. Otherwise colourless transparent, with the following marks: Anterior

tarsi faintly darker, all claws brown; sterno-pleural sutures narrowly darkly outlined, a pale median dorsal line from behind the head to above the ovipositor; pronotum and propodeon each with two or more or less defined triangular darker spots about the mid line. The tergites (except medianly) are faintly infuscated, so that the abdomen is indistinctly banded; on the 7th tergite (bearing the setigerous process) the band is darker, narrow, and distinct. Sternites a little infuscated; ovipositor reddish brown.

♀. *Head* from in front (7 : 6); frons narrowest ($\frac{2}{3}$ of the width) at two-thirds above the clypeal edge. Toruli well below the base-line of the eyes, three-fourths their own length from the mouth-opening and nearly twice (11 : 6) their length apart. Pattern

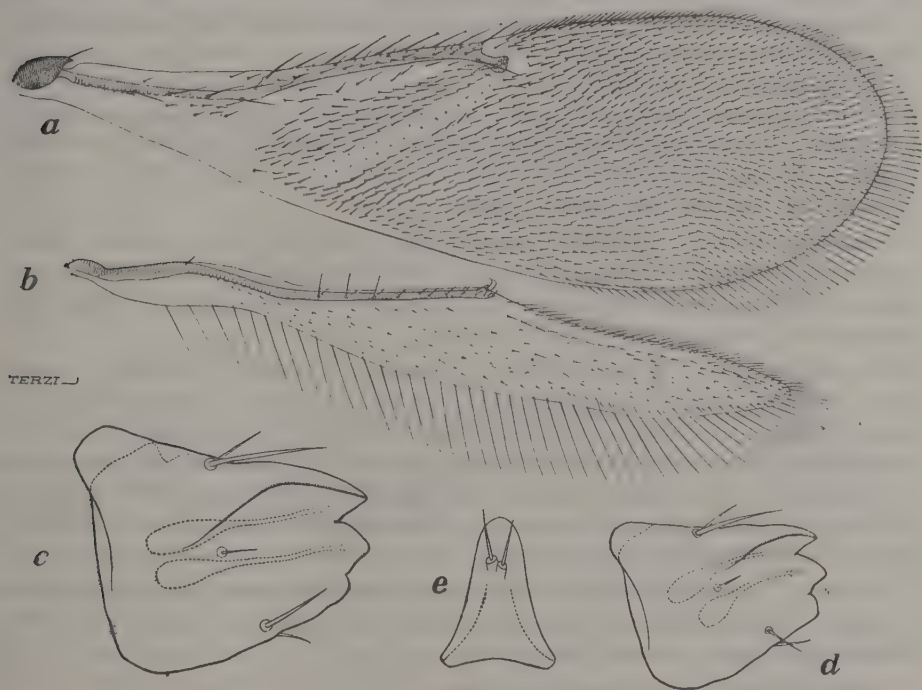


Fig. 5. *Paraphelinus perkinsi*: (a, b) wings of ♀; (c) left mandible of ♀; (d) left mandible of ♂.

P. xiphidii: (e) labrum of ♀.

on vertex and frons (except just between the scapal grooves, where the surface is nearly smooth or finely mamillated) large, raised on vertex and upper frons, but very faint on the face; clypeus smooth. Along each lower orbit are 5-6 bristles and about the same number (strong) superiorly; nearly a dozen smaller bristles between the orbital row and the mid line, on the upper angles of the frons; 5-6 minute bristles inside the genal keel and 9-10 pairs of bristles between and above the toruli; the two clypeal bristles are well above the edge.

Antenna (fig. 2, a): length, .42 mm.; bulla (2 : 1) five-eighths of the scape. The latter narrow (5 : 1), with 6 bristles along the ventral edge, 6-8 on the outer

apical half, about 10 on the dorsal edge, and 20 on the inner surface evenly but sparsely disposed. Surface, especially on the inside, with large-celled little-raised reticulation. Pedicel (25 : 11) scarcely half the scape. Funicle shorter than either club or scape, being about four-fifths of the former or three-fourths of the latter. First funicular (9 : 7) (measuring to the ventral apical angle) equal to one-sixth of the scape. In the same scale, the 2nd and 3rd funicular joints are (12 : 9) and (16 : 13) respectively. The club (45 : 15) is five-sixths of the scape and bears 5-6 sensoria. Bristles of pedicel sparse and evenly set, as on the scape; on the first funicular, round the insertion of the second and along the short dorsal edge are 6-7 bristles, and one on the inner ventral angle; from the 2nd funicular onwards the bristles are more closely set, shorter and fewer; on the club they are numerous and more appressed.

Thorax: pronotum with the bristles weaker than in *xiphidii*, and an extra one on the posterior edge near the middle. Proportions much as in *xiphidii*, scutellum longer (5 : 6), mesophragma to scutellum as 17 : 10, and longer than mid lobe (17 : 15). The four pairs of median bristles are in two nearly parallel lines, converging very slightly anteriorly. In *xiphidii* the first pair immediately behind the pronotum are a little nearer to one another, and the second pair (and sometimes the third) more outwardly displaced, so that the lines are not parallel.

Propodeon: the pre-spiracular propodeal fold is distinctly shown only for a short distance anteriorly, i.e., beside the spiracle. Posteriorly there are only some indistinct longitudinal rugae ending at the side of the petiole. Spiracle relatively larger and broadly oval, with two minute bristles outside.

Wings (figs. 5 a, 6): *Forewings* (3·1), length, ·8 mm.; breadth, ·26 mm.; broader than in *xiphidii* with two more macrochaetae on the marginal and 1-2 additional minute bristles below the submarginal distally (cf. also the disposition of the 6-7 rows of longer bristles below the marginal to that vein). The bare area beyond the radius smaller. *Hind wings* broader, not eight times as long as broad; length, ·68 mm.; breadth, ·09 mm.; numerous bristles at apex. Longest hairs of fringe about three-fourths the breadth.

Abdomen: free portion of sheath much as in *xiphidii*, but the long bristles are nearer the apex. Above the sheath the short bristles are very numerous, 14-16, the last (below the setigerous process) being longer.

Length, ·85 mm.; *alar expanse*, 1·8 mm.

♂. Like the female, paler if anything on head and thorax, mandibles apically darker. The fore legs darker than in the female.

Antenna (fig. 4, b): length, ·28 mm. *Forewings* (fig. 4, c): length, ·54 mm.; breadth, ·18 mm. *Hind wings*: length, ·44 mm.; breadth, ·07 mm.

***Paraphelinus tomaspidis*, How. (1914).**

♀. *Head*: from in front, ciliation of eyes very short and sparse. Clypeal teeth distinct. Between and above the toruli three pairs of bristles, 2-3 bristles inside each genal keel; between the orbits and mid line at the level of the anterior ocellus merely 2-3 bristles. At the same level the frons is one-half the width (just wider than in *xiphidii*).

Antenna (fig. 1, c): length, .3 mm.; bulla over one-third of the scape (4:11). The latter only a little over four times as long as broad (33:8). Bulla + scape longer than pedicel + funicle. Club (nearly 4:1) elongate, three times as long as the last funicular, and exceeding either funicle or scape. Bristles of scape much as in *xiphidii*, except that there are only 3-4 bristles on the anterior apical half, and about 10 posteriorly.

Wings (fig. 6). *Forewings*: length, .5 mm.; breadth, .142 mm.; narrowed basally, narrower than in either *xiphidii* or *perkinsi*, about $3\frac{1}{2}$ times as long as broad. The oblique hairless tract with convergent sides and obscured on about the anterior half, with 10-11 bristles below the submarginal. *Hind wings* (9:1) elongate, narrow and pointed; length, .45 mm.; breadth, .05 mm.; almost as long as the forewings, and nearly bare apically. Longest bristles of fringe exceeding the greatest width.

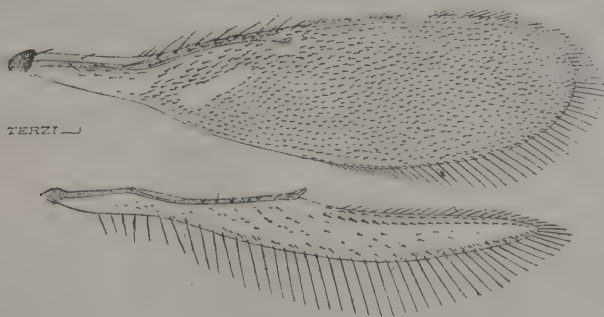


Fig. 6. *P. tomaspidis*, How., ♀, wings.

Abdomen not twice as long as thorax and propodeon. Ovipositor distinctly projecting and exceeding its sheath. The free portion of the latter with two longer ventral bristles, two shorter above, and a number of minute ones at the apex; there are 9 short bristles in a patch above the distal end of the base of the sheath.

Length, .8 mm.; alar expanse, 1.1 mm.

Mr. Williams' example is a little smaller than the genotype, with which however it agrees in having the "hairless line" incomplete.

The following is a comparative description of the legs of the three species here dealt with:—

Fore legs: coxae of *xiphidii* with 10-11 bristles anteriorly (about 15 in *perkinsi*, 7 in *tomaspidis*); femur about 4:1 in *perkinsi*, narrower (5:1) in *tomaspidis*; comb of first tarsal joint 13-14 in *perkinsi*, 9 in *tomaspidis*, 10-11 in *xiphidii*. *Mid legs*: 4-5 stiff bristles on coxa; first tarsal joint with 3-4 spinose bristles on apical posterior edge. *Hind legs*: coxae bare, but for two bristles above the trochanter and one antero-ventrally; femur (*xiphidii*) anterior subventral row of 6-7 widely spaced bristles and two irregular subdorsal rows of 6-7 each, on apical two-thirds; in *tomaspidis* only 7-8 subdorsal bristles in all, none below one half; tibial comb in all three species with 8-9 spines.

In the chaetotaxy of the legs *xiphidii* and *perkinsi* agree more closely, *tomaspidis* being a barer species. The first tarsal joint of the mid and hind legs is also rather

shorter, the first and second being nearly 5 : 4, as opposed to 4 : 3 in the other species. In the figures of the wings special attention should be given to the shape of both fore and hind pairs and to the distribution of the minute bristles on the basal half. It is noteworthy that in these respects ♀ *tomaspidis* approaches somewhat to ♂ *perkinsi*.

Bibliography.

1. Giraud, J. Verh. Zool.-Bot. Ges. Wien, xiii, p. 1278.
2. Swezey, O. H. Report of the Work of the Experiment Station of the Hawaiian Sugar Planters' Association, Division of Entomology, Bull. no. 1, pt. 7, p. 214, December 1905.
3. Perkins, R. C. L. Ibid., Bull. no. 1, pt. 8, pp. 245 & 264, January 1906.
4. Swezey, O. H. Proc. Haw. Ent. Soc., ii, pt. 1, p. 21, October 1908.
5. Perkins, R. C. L. Fauna Hawaiiensis, ii, pt. 2, suppl., p. 658, 17th December 1910.
6. Girault, A. A. Jl. New York Ent. Soc., xix, p. 181, September 1911.
7. Mercet, R. G. Los Afelininos, pp. 32, 35, 45, 107, 108, 110, 290, 30th December 1912.
8. Girault, A. A. Arch. f. Naturg., lxxix, Abt. A., pt. 6, p. 74, September 1913.
9. Girault, A. A. Mem. Queensland Museum, pp. 181-184, 10th December 1913.
10. Howard, L. O. Proc. Ent. Soc. Wash., xvi, p. 81, June 1914.
11. Girault, A. A. Mem. Queensland Museum, pp. 45-47, 4th June 1915.

All the above (except 1) contain explicit references to *Paraphelinus*, but every described yellow or reddish species of *Aphelinus* will ultimately require to be studied before the limits of *Paraphelinus* are understood.

A NEW THRIPS DAMAGING ORCHIDS IN THE WEST INDIES.

By C. B. WILLIAMS, M.A., F.E.S.

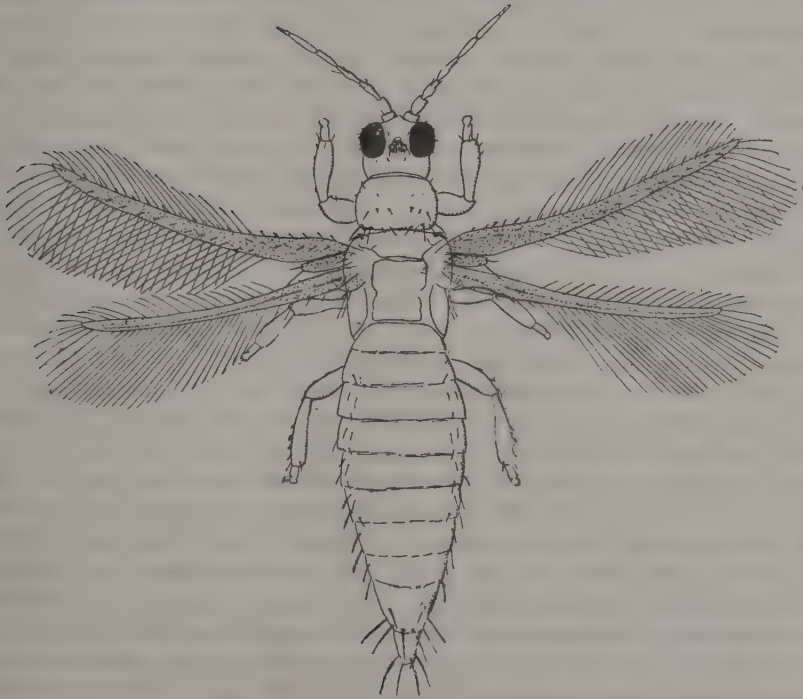
The thrips described below has recently been a source of considerable damage to orchids grown for ornamental purposes in Trinidad, West Indies. Up to the present it has not been found on wild orchids and it is possible that it is not indigenous to this island. A large number of orchids are brought over from Venezuela and it may have been imported with them from that country.

Order *THYSANOPTERA*.

Family *THRÍPIDÆ*.

Physothrips xanthius, sp. nov.

♀. *Measurements*.—Total length, about 0·9 mm. Head, length, 0·076 mm., width, 0·132 mm.; prothorax, length, 0·088 mm., width, 0·160 mm.; pterothorax,



greatest length, 0·180 mm., width, 0·200 mm.; abdomen, width, about 0·180 mm.; wing, length, 0·580 mm., width of middle, 0·028 mm.

Antennae	..	1	2	3	4	5	6	7	8
length (μ)	..	22	31	34	48	40	52	9	14
width (μ)	..	29	24	18	17	15	13	6	4

Total length of antenna, 0·290 mm.

Coloration.—Body and legs almost uniformly pale yellow, the fore part of the head very slightly darker. Antennae a little darker brown, except for the bases of the third and fourth segments, which are very pale. Eyes black; ocellar pigment reddish orange. Wings brown, distinctly darker than the body, with the central portion of the outer half a little paler than the margins.

Head not quite twice as broad as long; the cheeks not arched. *Eyes* large, very slightly projecting; distance between the eyes greater than the width of the eye; distance from the eye to the back of the head about half the length of the eye. *Ocelli* on a level with the middle of the eye, the three forming an obtuse triangle; the posterior pair about twice as far apart as they are distant from the margin of the eye; the anterior ocellus directed forward. Ocellar and post-ocular spines and a few smaller ones on the vertex, pale and indistinct; the ocellar spines arise from the sides of the ocellar triangle. *Mouth-cone* bluntly rounded, reaching about two-thirds across the prosternum. *Maxillary palps* short, three-segmented; the basal segment short, the two others subequal. *Labial palps* slender, apparently two-segmented. *Antennae* eight-segmented, relatively long, being three and a half times the length of the head: the first segment short and broad; the second barrel-shaped; the third with a distinct pedicel and narrowed to a slight neck at the apex; the fourth widest at about half its length, but narrowing rapidly apically to a long neck; the fifth with a distinct ring joint at its base, truncate apically; the sixth long and gradually tapering; the eighth half as long again as the seventh. Forked trichomes on the third segment dorsally and the fourth ventrally, that on the third segment reaching just beyond the base of the fourth, and that on the fourth reaching to about one-third the length of the fifth segment. *Prothorax* about one and two-thirds as wide as long, all angles rounded. Two pale spines at each hind angle of the pronotum each about half as long as the dorsal length of the pronotum; short spines at the front angles, other small spines very inconspicuous. *Pterothorax* normal; at the front angle there is, more or less distinct, a small double tooth-like projection in front of the base of the fore wing, one portion of this is long and slender, the other short and broad. *Legs* normal. *Wings* fully developed; veins on the fore wing almost invisible, only indicated by the position of the bases of the spines. On the costa there are 20–21 spines; on the fore vein two groups of 3 near the base and 2 near the apex; on the hind vein 11–13. The anterior fringe commences just distal to the base of the hind vein; the posterior fringe extends a little further towards the base of the wing. Hind wings paler than the fore wings, with a rather broad dark, central vein distinct almost to the apex of the wing. The minute setae on both wings are dark and conspicuous. *Abdomen* normal; the ninth segment longer than the tenth; spines on the last two segments pale, those on the ninth segment about as long as the tenth segment, those on the tenth segment a little longer. No trace of comb-like structure on the hind margin of the eighth tergite.

♂ unknown.

Described from about a dozen females collected on *Cattleya* orchids in Port of Spain, Trinidad, on various dates during 1915 and 1916 by F. W. Ulrich and C. B. Williams.

Type in the author's collection.

This species is chiefly recognisable by its yellow body colour, brown fore wings and the relatively long antennae.

The larvae and pupae are found with the adults on the upper surfaces of the leaves, particularly near the mid rib and towards the base of the leaf. They cause injury by piercing the surface, resulting in brownish spots or patches on the leaves. In severe cases the plant may be entirely killed.

NEW ETHIOPIAN FRUIT-FLIES OF THE GENUS DACUS.

By Prof. M. BEZZI.

Since the publication of my previous paper on the Ethiopian fruit-flies of the genus *Dacus*,* I have received some additional species, the descriptions of which are given in the following pages, with the purpose of completing our knowledge of this very important genus of Diptera. For the material here illustrated I am indebted to Dr. Guy A. K. Marshall, Director of the Imperial Bureau of Entomology, and to Dr. Alberto Mochi, of Ghinda, Erythraea : to whom I have to offer my best thanks.

I. Subgenus *TRIDACUS*, Bezzi, 1915.1. *Tridacus d'emmerezi*, sp. nov. (fig. 1).

Very distinct from any other known species of the present group, on account of the broad fuscous patch on the middle of wings, around the small cross-vein.

♂♀. Length of body, 7-9 mm.; length of wing, 6-7 mm.

Body of a uniform reddish colour, with less striking yellow and brown markings; thorax and abdomen with short yellowish pubescence on the disk; all the bristles of head and thorax black. Head of a more yellowish colour, opaque, but shining on the occiput, which has a paler border near the eyes; ocellar dot dark brown, on a brown transverse band; frons with a less developed fuscous middle spot, with almost indistinct dark dots on the sides and with two pairs of lower fronto-orbital bristles, which are not approximated; lunula reddish brown, shining; face with shining antennal grooves, in the middle of which are placed the very small and rounded black spots; peristomial spot dark brown. Antennae much elongated, with the first joint about as long as the second; they are entirely reddish, the third joint being sometimes a little infuscated at the distal end; palpi very broad, pale yellowish, almost bare. Thorax with some irregular, blackish markings on the disk, forming two more or less distinct longitudinal stripes, which do not reach the scutellum, or two less distinct broader interrupted stripes along the dorsocentral lines. Yellow markings as follows: humeral calli entirely; a narrow stripe along the transverse suture, broadly interrupted in the middle, and continued on the pleurae with the broader mesopleural band, which ends with a small spot on the upper border of the sternopleura; two broad contiguous hypopleural spots, which are margined inwardly, in front of the insertion of the halteres, with a conspicuous blackish patch. The anterior supra-alar bristle is well developed, like the two posterior ones; the four scapular ones are long and strong; the pteropleural is well developed. Scutellum yellow, with the base narrowly reddish brown, and with a pair of long apical bristles. Mesophragma reddish, with the above-mentioned dark spot on the sides. Halteres whitish yellow. Abdomen elongate, rather constricted near the base; hind border of the second segment with a broad yellowish band, which is more or less interrupted in the middle; sides of the first, sometimes of the second and middle of the third segments provided with more or less distinct, but not sharply defined, dark brown

* Bull. Ent. Research, vi., Sept. 1915, pp. 85-101, 14 figs.

or blackish markings; venter reddish, the second segment with a yellow band. Third segment of the male with 8-10 long, black cilia at the sides of the hind border; ovipositor not longer than the last abdominal segment, reddish yellow, with the basal segment depressed. Legs of a prevalent pale reddish colour, but the coxae and the trochanters dark reddish-brown or blackish; the basal half of the femora and all the praetarsi pale yellowish. Wings (fig. 1) of rather large size, with the veins reddish yellow; last portion of fourth vein gently bisinuous; second longitudinal vein long, the distance of its end from that of the first being not much shorter than the distance from that of the third; small cross-vein long, its lower end placed much after the middle of the discal cell; lower prolongation of the anal cell longer than the distance of its end from the hind border of the wing. They are hyaline, with a broad, pale yellowish fore border; which includes the stigma, but excludes the costal cells, and is not extended over the third vein, or only a little; in contact with this border is a broad and more infuscated patch, surrounding the small cross-vein and encroaching more or less on the upper end of the discal cell. Anal stripe very broad and more infuscated than the marginal one.

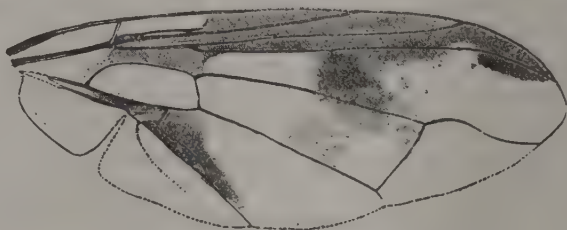


Fig. 1. *Tridacus d'emmerezi*, Bezzi, sp. n.

Type ♂ and type ♀, and some additional specimens, in the collection of the Imperial Bureau, from Mauritius, Reduit, 1916, collected by Mr. D'Emmerez de Charmoy, in whose honour this interesting species is named.

II. Subgenus DACUS, Bezzi, 1915.

In my Key to the species (l.c., p. 89) the section 21 (22) must be amplified as follows:—

21 (22). Face without black spots.

a (b). Two contiguous hypopleural spots; third abdominal segment of male ciliated; wings with a brown anal stripe *immaculatus*, Coq.

b (a). A single hypopleural spot; male with the third abdominal segment not ciliated; wings without an anal stripe.

c (d). Frons with three pairs of blackish dots near the eyes; abdomen entirely black along the middle line; wings with the submarginal cell hyaline at base over the small cross-vein. *annulatus*, Becker.

d (c). Frons with the basal half brown, the apical half yellowish, and without black dots; abdomen with a broad, reddish yellow, longitudinal middle band, which is divided by a black line; wings with the submarginal cell broadly infuscated at base and with the upper end of the small cross-vein margined with fuscous *mochii*, sp. n.

2. *Dacus annulatus*, Becker, 1903 (fig. 2).

An elegant species, well distinguished by the entirely black yellow-marked body, by the unspotted face, by the single hypopleural spot, by the unciliated third abdominal segment of the male, and by the lack of the anal stripe on the wings.

The face is unspotted, but usually there is a more or less developed black or blackish spot on the upper edge of the clypeus, just below the base of antennae. All the bristles are black; two pairs of distant lower fronto-orbital bristles; only the external scapular bristles are well developed, the middle ones being rudimentary; no anterior supra-alar; pteropleural well developed. The sutures of the abdominal segments are partly fused in the middle. The legs are pale yellowish, as described by the author; but in some ♂ specimens the apical third of the hind femora, and sometimes the whole of the hind tibiae, are black. Wings (fig. 2) with the second longitudinal vein short, the fourth segment of the costa being about one-third the length of the fifth; prolongation of the anal cell not longer than its distance from the hind border.

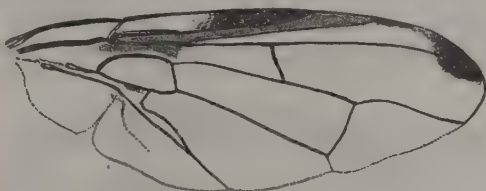


Fig. 2. *Dacus annulatus*, Becker.

The present species was collected by Ehrenberg in Egypt about a century ago and described rather recently by Becker from the original specimens; I have before me numerous examples from Ghinda, Erythraea, December 1916, collected by Dr. A. Mochi, who has found the species very common there. This species has already been recorded from Erythraea (Asmara, leg. Kristensen) by Dr. Enderlein and by Dr. Speiser, both in 1911.

3. *Dacus mochii*, sp. nov. (fig. 3).

Nearly allied to the preceding species, but at once distinguished by the very differently coloured frons and abdomen, and by the peculiar wing-pattern.

♂. Length of body, 5.5-6 mm.; length of wing, 4.5-5 mm.

Occiput shining black above, with a narrow yellowish border, and pale yellowish below; ocellar dot black; frons with the basal half infuscated, the apical half pale yellowish, destitute of blackish lateral dots; lunula shining brown; face pale yellowish, immaculate, shining only along the antennal grooves; peristomial spot wanting. Antennae of moderate length, the first joint not elongated; they are dark yellowish, with the third joint infuscated at the distal end; palpi and proboscis pale yellowish. The bristles of the head are black; there are two pairs of lower fronto-orbitals, one very near the dividing line between the face and frons, the other at the level of the dividing line between the dark and the clear portions of the frons. Thorax entirely black, even on the pleurae, with short whitish

pubescence on the back. The wax-coloured markings are as follows: humeral calli entirely; a short and narrow stripe on each side of the transverse suture; a very broad, spot-like patch (about double as broad as the corresponding band of *annulatus*) occupying almost the whole of the mesopleura and the adjoining part of the pteropleura, ending with a small spot on the upper border of the sternopleura; a single rounded hypopleural spot. Mesophragma entirely black. Scutellum wax-coloured, with a very narrow, black, basal stripe. Halteres whitish. All the bristles are black; no trace of anterior supra-alars; pteropleurals weak; scapulars not distinguishable in the type; two scutellars. Abdomen ovate, punctate and pubescent like the pronotum, a little constricted near the base; it is black, but has a broad yellowish band at hind border of second segment, like *annulatus*, and besides a broad yellow middle band extending from hind border of second segment to the end, where it is dilated and occupies almost the whole hind half of the last segment; along the middle of this yellow band there is a narrow black stripe, dilated at base and attenuated before reaching the tip; the sutures of the segments are partly fused and the third is not ciliated at the sides. Venter yellow, with dark or blackish sides; genitalia reddish. Legs with the coxae entirely of a pale yellowish colour, the ends of the femora and the four apical joints of the tarsi being a little reddish. Wings (fig. 3)



Fig. 3. *Dacus mochii*, Bezzi, sp. n.

hyaline, with brownish veins; second vein short; small cross-vein a little beyond the middle of the discoidal cell; last portion of fourth vein gently curved at base; prolongation of the anal cell proportionally short. There is a narrow blackish fore border, which leaves the costal cells hyaline, but is more intensively coloured on the stigma; below this, the fore border is dilated, filling broadly the base of the submarginal cell and surrounding the upper end of the small cross-vein; at its end the marginal band is a little dilated, but without forming a distinct spot at the end of third vein. There is no trace of an anal stripe, the anal cell being only a little yellowish on its upper half.

Type ♂, and an additional specimen of same sex, in the writer's collection, taken near Ghinda, Erythraea, December 1916, by Dr. *Alberto Mochi*, in whose honour the species is named.

4. *Dacus woodi*, sp. nov.

Exceedingly close to the preceding species (*D. mochii*), and resembling it in its unspotted face and unciliated third abdominal segment of the male, but differing in the colour of body and in the not infuscated upper end of the small cross-vein.

♂♀. Length of body, 5.5–6 mm. ; length of wing, 4.5–5 mm. The species differs from *M. mochii* in the following points :—

(1). The basal half of frons is yellowish, and therefore there is a very distinct dark transverse band on the middle ; the lunula is pale yellowish, not brown. (2). The thorax is prevalently of a reddish, not black, colour, chiefly in front and on the pleurae ; all the markings and the scutellum are of a bright yellow colour ; the mesophragma is distinctly reddish on the sides, not entirely black. (3). The abdomen has the second segment more broadly yellow ; the longitudinal yellow band is broader and has no middle black line in the male. (4). The wings have the base of the submarginal cell broadly infuscated, but this infuscation is not continued over the upper end of the small cross-vein.

The female is very like the male, but the abdomen has the second segment more broadly black, and there is a middle black line in the longitudinal yellow stripes. Ovipositor entirely reddish-yellow, shining, with the basal segment swollen, about as long as the last abdominal segment, but not much prominent.

Type ♂, type ♀ and additional specimens of both sexes in the collection of the Imperial Bureau, from Nyasaland, Chiromo, Ruo. R., 22.ix.1916, collected by *R. C. Wood*, in whose honour the species is named.

5. *Dacus hamatus*, sp. nov. (fig. 4).

A very distinct species, which in my key falls into section 25 (p. 90), but is distinguished from *inornatus* and from any other known species by the exceedingly peculiar wing pattern, and by the longitudinal keel of the abdomen.

♂♀. Length of body, 6–6.5 mm. ; length of wing, 5–5.5 mm.

Head entirely of a shining black colour, even on frons and face ; occiput with a narrow and short, spot-like stripe on each side on the orbits ; frons with a pair of yellow dots on the basal half ; lunula yellowish brown ; the frons shows anteriorly a rounded prominence, which is peculiar to this species. Antennae dark yellowish, with the two basal joints very short, the second with some black bristles above, the third very elongate, blackish on the apical half ; palpi broad, of a reddish colour ; proboscis black. Cephalic bristles black ; two pairs of distant lower fronto-orbitals. Thorax entirely black, punctate, with a short dark pubescence on the back, which is paler at the sides. The very striking yellow markings are as follows : a rounded humeral spot, which covers only the hind half of the humeral calli ; the fore half being black ; there is no sutural stripe, only the notopleural calli at the beginning of the suture being yellow ; an oval spot in the middle line of the back, behind the suture ; a broad mesopleural patch, extended on to the pteropleura and ending with a small spot on upper border of sternopleura ; a single hypopleural spot. Mesophragma entirely black, punctate, a little shining. Halteres pale yellowish. Scutellum yellow, with a narrow black base and with a pair of bristles. All the bristles are black ; there is no trace of anterior supra-alars ; pteropleurals well developed ; only the external scapulars are strong. Abdomen rounded, convex, constricted at base ; along the middle line there is a very peculiar obtuse keel, which on the middle segments is rather prominent ; it is clothed with dark pubescence, which at the sides of the base is greyish, erect and rather long. The abdomen is

entirely black, opaque, punctate; only the last segment is more or less reddish in the middle of the hind border; the segments are fused together in the middle, and the third of the male is not ciliated; ovipositor shining black, smooth, with the basal segment swollen and of conical shape, not longer than the last abdominal segment; apical segment short, reddish yellow. Venter entirely black; male genitalia dark brown, surrounded with yellowish. Legs with coxae, trochanters and femora shining black, but the middle pair with a narrow base, and the hind pair with more than the basal half, yellowish; tibiae yellowish, with blackish or darkened basal half; tarsi pale yellowish, with whitish basal joints. Wings (fig. 4) hyaline, with yellowish veins, which are darkened on the dark markings; second vein long, its distance from the end of the third being only $1\frac{1}{2}$ times longer than that from end of the first; third vein straight at the end and parallel with the last portion of the fourth, which is only a little curved near the base; the lower end of the small cross-vein is placed at the middle of the discal cell; the prolongation of the anal cell is shorter than the remainder of the anal vein.* The dark pattern consists of the black stigma, the infuscated bases of the marginal and submarginal



Fig. 4. *Dacus hamatus*, Bezzi, sp. n.

cells, and a very peculiar, hook-shaped band, which passes over the small cross-vein, crosses the middle of the discal cell and ends sometimes with a short prolongation in the third posterior cell. There is no trace of an apical spot or anal stripe.

Type ♂ and type ♀, and some additional specimens of both sexes, in the collection of the Imperial Bureau, from Nyasaland, Chiromo, Ru. R., 11.v.1916 (*R. C. Wood*).

The present species, with its characteristic wing pattern, seems to approach to the Oriental species with banded wings, for which I have preserved the genus *Bactrocera* in a restricted sense; these last species however are always provided with a pair of praescutellar bristles.

6. *Dacus blepharogaster*, sp. nov. (fig. 5).

Falling into section 28 of my Key (p. 90), but very different from *rufus* on account of its prevalently black colour; it is besides distinguished from *annulatus* and *mochii*, to which it is allied in general appearance, by the black-spotted face and by the ciliation of the third abdominal segment in the male.

♂. Length of body, 7 mm.; length of wing, 6 mm.

* All these peculiarities of the venation are to be found also in the nearly allied *inornatus*, Bezzi, which however has no trace of the longitudinal keel on the abdomen.

Head yellowish; occiput shining, with the vertex reddish with two black spots and with a broad blackish patch on each side; orbits yellow, broadened below; ocellar dot black; frons opaque, with three pairs of blackish dots on the sides and an undetermined fuscous patch in the middle; lunula shining black; face entirely shining, with a broad rounded black spot on lower half of each antennal groove; peristomial spot broad and black. Antennae entirely reddish yellow, the third joint a little infuscated at the end, the first joint much shorter than the second; palpi and proboscis reddish yellow. Cephalic bristles black; two pairs of distant lower fronto-orbitals. Thorax entirely black, slightly reddish on the sides in the hind half and along the pleural sutures, chiefly on the front half. The bright yellow markings are as follows: humeral calli entirely; a short triangular stripe along the sides of the transverse suture; a rather broad mesopleural stripe, ending with a spot on upper border of sternopleura; a single hypopleural spot. The back is punctate and clothed with short greyish pubescence; mesophragma entirely black. Scutellum bright yellow, with a narrow black basal line. Halteres whitish. All the bristles are black; no trace of anterior supra-alars; the middle scapulars are well developed, like the external ones; pteropleurals rather weak; a single pair of scutellar bristles. Abdomen in shape, colouring, punctuation and pubescence like that of *annulatus*; but it is less elongate, more oval; the hind

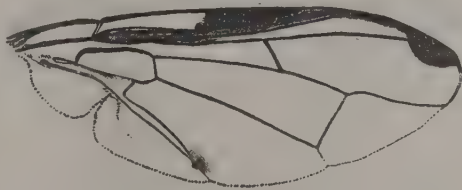


Fig. 5 *Dacus blepharogaster*, Bezzi, sp. n.

border of the third segment has also a narrow yellowish band; third segment with 6-7 black cilia at the sides of the hind border. Legs with the coxae pale yellowish, the middle and hind femora being dark reddish at the end; all the tibiae are broadly darkened, the posterior ones being entirely black; tarsi reddish brown, with all the praetarsi whitish. Wings (fig. 5) hyaline, with the fore border and the apical spot as in *annulatus*, but there is a distinct greyish spot before the end of the anal vein, which is entirely wanting in that species. The veins are yellowish and their disposition is like that of *annulatus*, but the prolongation of the anal cell is much more developed, being longer than the rest of the anal vein.

Type ♂, a single specimen in the writer's collection, taken near Ghinda, Erythraea, 7.xi.1916, by Dr. Alberto Mochi.

7. *Dacus erythraeus*, sp. nov. (fig. 6).

Allied to the preceding species, but distinguished by the smaller facial black spots and by the non-ciliated third abdominal segment of the male; and also differing from it and from *annulatus* and *mochii* by the broader black base of the scutellum and by the isolated blackish apical spot of the wings.

In my Key the present species falls into section 27 (p. 90) together with *oleae*, which also occurs in *Erythraea*,* but has no real affinity with it.

♂♀. Length of body, 5.5–6.5 mm.; length of wing, 5–6 mm.

Occiput black, rather shining, with narrow yellowish orbits, which are broadened below; ocellar spot shining black; frons opaque, with the basal half reddish brown and the apical half pale yellowish, but with three distinct pairs of broad blackish dots on the sides; lunula shining red or brownish; face pale yellowish, shining, the black spots being more stripe-like and placed on the inner border of the antennal grooves near the mouth-border; peristomial spot less darkened, but distinct. Antennae reddish, with the first joint short and the third infuscated at the end; palpi pale yellowish; proboscis reddish. Cephalic bristles black; two pairs of strong and distant lower fronto-orbitals. Thorax entirely black, even on the pleurae, or only with a reddish stripe near the prothoracic stigma. Yellow markings as follows: humeral calli entirely, but with a black border above and in front; a narrow, triangular and short sutural stripe on each side; a rather narrow mesopleural stripe, ending with a very small and less distinct sternopleural spot; a single hypopleural spot, which is broadly margined with black below. Scutellum bright yellow, with a basal black band, which is much broader than



Fig. 6. *Dacus erythraeus*, Bezzi, sp. n.

in all the preceding species. Mesophragma entirely black. The back of the thorax is punctate and clothed with short whitish pubescence. The bristles are black; no anterior supra-alars; scapulars short, the middle ones not distinct; pteropleurals well developed; two scutellar bristles. Halteres whitish. Abdomen elongate in the male, more rounded in the female, convex, punctate, with whitish pubescence, which on the sides is rather long. It is black; the second segment has a rather broad, pale yellowish, transverse band at the hind border, which is broadly interrupted in the middle; fourth and fifth broadly reddish in the middle, forming a triangular patch with the base behind and provided with a middle longitudinal black line, which does not reach the hind border of the last segment. Venter yellowish, irregularly blackened towards the middle. Male with non-ciliated third abdominal segment and with shining red genitalia. Ovipositor short, as long as the last abdominal segment, but not prominent, reddish, with the basal segment rather inflated but not conical. Middle segments of the abdomen in both

* F. Silvestri. Viaggio in Eritrea per cercare parassiti della mosca delle olive (Boll. del Labor. di Zool. gen. e agr., Portici, 1914, ix, pp. 186–226, 24 figs.).

F. Silvestri. Contributo alla conoscenza degli insetti dell' olivo dell' Eritrea e dell' Africa meridionale (l.c., 1915, ix, pp. 240–334, 78 figs.).

sexes with the sutures partly obliterated. Legs pale yellowish; front femora brownish at the end; four posterior femora broadly black at the end; middle tibiae black at the base exteriorly, hind tibiae entirely black; praetarsi paler than the other joints. Wings (fig. 6) hyaline, with blackish veins; second vein short, the fourth segment of the costa being about one-third the length of the fifth; third vein rather straight and parallel with the last portion of the fourth, which is less curved near the base; lower end of the small cross-vein placed after the middle of the discal cell; prolongation of the anal cell longer than the remainder of the anal vein. The very reduced pattern consists only of the black stigma, the infuscated marginal cell and an isolated blackish spot at the end of the third vein; there is no distinct grey spot at the end of the anal cell.

Type ♂ and type ♀, a single pair of specimens in the author's collection, from Ghinda, Erythraea, 3.xii.1916, collected by *Dr. Alberto Mochi*.

NOTES ON SOME DISTINCTIVE POINTS IN THE PUPAE OF WEST AFRICAN MOSQUITOS.

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Wesché employed the relative length of the trumpets to the length of the thorax and the shape of the openings of the trumpets in drawing up a Key to the Pupae of West African Culicidae (Bull. Ent. Res., i, pp. 18-19). Howard, Dyar and Knab in their valuable monograph "The Mosquitoes of North and Central America and the West Indies" (Vol. i, pp. 102-103) state that in their experience too much has been made of the difference between the pupal trumpets of *Anopheles* and *Culex*; the variations in the shape, size, and length of the breathing trumpets between different species are numerous, they say, but "furnish no characteristics which are diagnostic of genera or larger groups." They consider that there are intermediate forms and that differences between species are frequently more striking than between genera themselves. They remark also that this may equally well apply to the differences in shape of the pupal paddles, admitting, however, that "there is a striking difference between the two tribes CULICINI and SABETHINI" as regards the paddles for "In the CULICINI the paddles are large, broad and rounded in outline; they are strengthened by a stout longitudinal midrib which bears a spine or seta apically. In the SABETHINI the paddles are much smaller, narrower and tapered to a point; the midrib is either absent or poorly developed and there is no spine or seta." It may be remarked here that in *Eretmopodites*, the only genus of the tribe SABETHINI up to the present known in Africa, the midrib is well developed in the pupal paddles and there is a long terminal seta, much longer than in the CULICINI. Howard, Dyar and Knab believe that "the greatest diversity among the pupae of mosquitoes will be found in the number and arrangement of the setae on different parts of the body. These, we are sorry to say, have not been adequately studied, but we are convinced that they will furnish both generic and specific characters"; and they point out that "there is a well-marked difference in the two tribes above-mentioned. In the SABETHINI the seventh and eighth abdominal segments each bear a pair of ample fan-shaped tufts at the apical angles; these are absent in the CULICINI."

Bacot takes up the question of the "possibilities of the pupal paddles (anal plates of Wesché) for purposes of classification and the separation of ill-defined species" of mosquitoes in his "Report of the Entomological Investigation undertaken for the Yellow Fever (West Africa) Commission" (pp. 140-146), stating that "very marked differences may occur in the pupal paddles of closely related species." Bacot qualifies this statement, however, by remarking that "there seems . . . no likelihood, so far as the scanty material examined goes, that these characters could be made to afford the basis for an independent scheme of classification." In the opinion of Bacot those appendages of the pupa which are obviously likely to be adaptive rather than ancestral in character may form a means of discrimination.

Following Bacot we have described the pupal paddles of a few mosquitos which, so far as we know, have not yet been illustrated in this particular manner. It seemed to us, after reading Bacot's paper, that, while helpful in the differentiation of certain species, a scheme of classification based *solely* upon the characters of the pupal paddles with their appendages would break down sooner or later. We must admit, however, that this break-down has not occurred so far as the examination of our materials has gone, yet the points of distinction are sometimes so slight that we believe that not only the numbers and arrangement of the setae on different parts of the pupal case should be taken into consideration, as suggested by Howard, Dyar and Knab, but also in certain cases the length and shape of the pupal trumpets, in attempting to draw up a scheme of classification based upon pupal characters alone. Such a provisional scheme we have outlined below for the pupae which have been figured by Wesché and Bacot, and for those we ourselves have had the good fortune to examine. Unfortunately we have not been able to avail ourselves of all the descriptions given by Wesché, as some of them are incomplete and his drawings, which were made at a low magnification, do not reveal certain minute points on which we have had to rely for the differentiation of species; this is especially the case in the genus *Culex*, in which we have had reluctantly to abandon the attempt to include his species in our scheme.

In drawing up this scheme we have relied as far as possible on the characters of the paddles and the setae on the last two abdominal segments. These structures furnished sufficient points for the differentiation of genera. In dealing with species, however, we have had to have resource to other characters in order to distinguish even the small number of pupae discussed, and it is probable that when further materials are available the setae on all or most of the abdominal segments and every other structure capable of giving assistance will have to be included in devising a complete scheme of classification.

Table of Tribes.

1. Paddles small, breadth less than half the diameter of the 8th segment; tufts on the 8th segment as long as the paddles or nearly as long	SABETHINI.
Paddles relatively large; tufts on the 8th segment shorter than the paddles	 2
2. Large species; long dorsal serrated hairs on the 7th and 8th segments	MEGARHININI.
Smaller species; without such long hairs	 3
3. Dendritic seta on the posterior angle of the 8th segment ..	ANOPHELINI.
Tuft or differentiated seta on the posterior angle of the 8th segment	CULICINI.

The only species belonging to the tribe MEGARHININI the pupa of which has been described is *Toxorhynchites brevipalpis*, which has been figured by Bacot. The large size of the pupa is at present sufficient to differentiate it from any other, but the insignificant size of the tuft on the 8th segment, the absence of terminal setae on the paddles, and the presence of long serrated dorsal setae on the 7th and 8th segments are also characteristic.

The pupae of *Eretmopodites*, the only genus of the tribe SABETHINI at present known to occur in Africa, differ from those of the SABETHINI described by Howard, Dyar and Knab, as has already been pointed out, in having well-developed midribs in the paddles, and long terminal setae or tufts of setae. The five species described, including one described by Bacot which is known only in the pupal stage, can readily be distinguished, as shown in the following table.

Genus ERETMOPODITES, Theo.

- | | |
|--|----------------------------|
| 1. Single stout seta on the end of the paddle | 2 |
| Tuft of about a dozen setae on the end of the paddle .. | <i>E. quinquevittatus.</i> |
| Tuft of about half a dozen setae on the end of the paddle .. | <i>E. inornatus.</i> |
| 2. A single stout seta on the posterior angle of the 8th segment .. | <i>E.?(undetermined).</i> |
| Tuft of long setae on the posterior angle of the 8th segment | 3 |
| 3. Tuft of four setae on the posterior angle of the 7th segment .. | <i>E. chrysogaster.</i> |
| Tuft of six setae on the posterior angle of the 7th segment .. | <i>E. dracaenae.</i> |

Genus ANOPHELES, Mg.

The pupae of only four West African species of this genus have hitherto been described in this way, namely those of *A. costalis*, *A. pharoensis*, and *A. mauritanus* by Wesché, and *A. funestus* figured by Bacot. The latter author also figured *A. costalis*. The pupa of *A. marshalli* is described here for the first time, and further details are given of those of *A. pharoensis* and *A. mauritanus* so as to make the descriptions of all the five species comparable.

Anopheles marshalli, Theo.

The pupal paddles are somewhat narrow, with a marginal fringe on the outer side. The thickening of the outer margin of the paddle or buttress, described by Wesché as present in the Anopheline pupae he examined, is also present in this species, but is less well developed than in *A. costalis*. There are two setae near the distal end of the midrib, the more distal one being the longer and stouter. The latter seta is not bent into a hook, as in the case of *A. costalis* and *A. funestus* in Bacot's figures, but is gently curved with the convexity inwards. The seta at the posterior angle of the 8th segment consists of branches coming off a main stem; the main stem is, however, much shorter than that of the lateral hairs of *A. costalis*. The 7th segment carries no lateral tuft, but bears a single seta at its posterior angle, which is simple, and internal to it there is a longer but more slender seta, also simple. On the posterior border of the 5th and 6th segments there are similar setae, but the inner setae are usually double, and between them and the setae at the angles there are smaller double hairs, which, however, are larger than the similar hairs on the 7th segment. At the posterior angle of the 4th segment there is a small knob-like seta. On the posterior margins of the 2nd, 3rd, and 4th segments there are several single, double and triple hairs, none of which however are strongly developed.

Anopheles pharoensis, Theo. (fig. 1).

The paddles are pyriform, with a slight external fringe, and have well developed midribs; they have also an external buttress, which is less developed than in *A. costalis*. There are two terminal setae on each paddle, a large and a small one, as in the other species of this genus. The large hair is not bifid, though the small one, which is poorly developed, may be split at its end. These hairs lie further apart than do the similar hairs in *A. mauritanus*, and the larger hair is longer than the larger hair on the paddle of *A. mauritanus* (9 units to 7).

There is a stout irregularly branching dendritic seta, much like that of *A. costalis*, at the posterior angle of the 8th abdominal segment; it is about one-fifth the length of the paddle. At the posterior angles of the 5th, 6th, and 7th segments are stout, curved and sharply pointed setae, longer than the similar setae on the segments of *A. mauritanus*. At the posterior angles of the 3rd and 4th segments are curiously stunted and blunted setae. Internal to the seta at the posterior

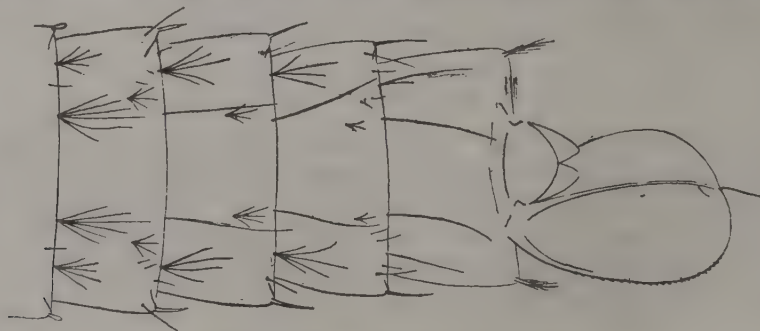


Fig. 1. *Anopheles pharoensis*, Theo.*

angle and at the posterior border of the segments on the dorsum is a tuft of hairs upon the 3rd to the 6th segments; these hair-tufts have fewer hairs than the similar tufts on *A. mauritanus*; on the 7th segment this hair-tuft is replaced by a single or bifid hair. Nearer the middle line of the dorsum on either side upon the posterior margins of the 5th, 6th, and 7th segments is a single stout hair extending to the distal margin of the segment over which it projects; this hair is replaced by a tuft on the posterior border of the 3rd and 4th segments. The trumpets have wide apertures, which are not fluted.

Anopheles mauritanus, Grp. (fig. 2).

The paddles are large and pear-shaped, with a slight fringe on their outer margins; they have well-developed midribs and also buttresses, which are slighter than those of *A. costalis*. The terminal hairs on each paddle are a large hair, which is usually bifid, and a small one, which may have its end split into three or four pieces. The hairs are slightly curved, but not hooked.

At the posterior angle of the 8th abdominal segment is a stout seta giving off delicate branches only upon its inner aspect; these branches all extend to about

* Unless otherwise stated the magnification of all the drawings is $\times 50$.

the same distance, namely to the termination of the seta itself, so that the branches coming off near the base are relatively long, while the others diminish in length progressively towards the apex—the appearance produced being suggestive of a harp.

There are short single stout setae with pointed ends at the posterior angles of all the segments proximal to the 8th, except the 1st. These setae gradually increase in size as the posterior end is approached. On the dorsal surface and at the posterior border of the segments immediately internal to the seta at the posterior angle there is a tuft of simple hairs on the 3rd to the 6th segments; on the 7th segment this tuft is replaced by a single or double hair. On each side nearer the middle of the dorsum on the posterior border of the 6th and 7th segments is a single or double stout hair extending slightly beyond the middle of the segment over which it projects; on the posterior border of the 3rd, 4th, and 5th segments this single hair is replaced by a tuft. The trumpets have wide apertures, which are fluted.



Fig. 2. *Anopheles mauritanus*, Grp.

With such a small amount of material it is scarcely worth while making out a table for identification, especially as there is no difficulty in separating the pupae, but a few of the many points of distinction may be briefly mentioned.

The buttress on the outer margin of the paddle is conspicuous in *A. costalis*, less well developed in *A. pharoensis*, and in *A. mauritanus*, as Wesché states, it is less well marked than in *A. pharoensis*. In *A. marshalli* it is only slightly developed. Unfortunately Bacot's figures do not show the buttress in either *A. costalis* or *A. funestus*.

The longer terminal seta on the paddle is "reminiscent of a boot-hook" in *A. costalis* and *A. funestus*, according to Bacot; in *A. marshalli* it is gently curved; in *A. pharoensis* it is almost straight, and in *A. mauritanus* it is usually bifid.

The dendritic setae on the posterior angles of the 8th abdominal segment also differ in these species. In *A. funestus* they are "larger, with less spread of the branches" than in *A. costalis*, according to Bacot. In *A. marshalli* they are smaller than in *A. costalis*, their length as compared with the length of the paddle being as 7 to 35 in the former, and as 12 to 36 in the latter. In *A. mauritanus* they are harp-shaped.

Tribe *CULICINI*.

Table of Genera.

1. Paddles of unusual shape.. .. .	2
Paddles of usual shape, oval or pear-shaped	3
2. Paddles narrow, without fringe; end of trumpet metamorphosed into a spine	<i>Mansonioides</i> .
Paddles "knife-like," inner lobes larger than the outer	<i>Uranotaenia</i> .
3. End of midrib thickened and tube-like	<i>Eumelanomyia</i> .
End of midrib not thickened, terminal setae present	4
4. Terminal setae long	5
Terminal setae short	6
5. Terminal setae very long; stout dendritic seta with a very long central branch a little internal to the tuft on the 7th segment	<i>Aëdomyia</i> .
Terminal setae shorter; no such dendritic seta on the 7th segment	<i>Aëdes</i> .
6. Tuft on the 8th segment small, no tuft on the 7th; paddles more or less infuscated.. .. .	<i>Mimomyia</i> .
Tufts on the 7th and 8th segments well developed	7
7. Long double hairs arising near the eyes	<i>Culiciomyia</i> .
No such hairs	<i>Culex</i> .

In the above table no attempt has been made to separate the genera *Stegomyia* and *Ochlerotatus*, but this will be referred to later when dealing with *Aëdes*.

Culiciomyia nebulosa possesses the two conspicuous hairs arising from a point near the eyes described by Wesché as present in the species he knew as *C. freetownensis* and *C. cinerea*, both of which have been sunk by Edwards. We do not know if these hairs are present in other species of *Culiciomyia*, but as we have not observed them in any species of *Culex* it is possible they may prove to be a distinguishing feature.

Genus *AËDES*, Mg.

The only species of *Ochlerotatus* that we have had the opportunity of examining differ from *Stegomyia* in having a small dendritic tuft on the 2nd segment similar to, but much smaller and more delicate than, that on the 1st segment. It may be possible therefore to differentiate these genera as follows:—

Tuft on the 1st abdominal segment dendritic, almost no stem;	
similar but smaller tuft on the 2nd segment	<i>Ochlerotatus</i> .
More decided stem to the dendritic tuft on the 1st segment; no	
similar tuft on the 2nd	<i>Stegomyia</i> .

Genus *STEGOMYIA*, Theo.

1. Tuft of setae on the posterior angle of the 7th segment	2
Single or double seta on the 7th segment	4
2. Paddles without a fringe	<i>S. sugens</i> .
Paddles with a fringe	3.

- | | |
|---|--------------------------|
| 3. Stout branched seta at the posterior angle of the 6th segment,
fringe shorter | <i>S. metallica.</i> |
| No such special seta on the 6th segment ; fringe longer ; midrib
more highly chitinised | <i>S. luteocephala.</i> |
| 4. Paddles narrow ; single seta or a poorly developed tuft on the
8th segment | <i>S. unilineata.</i> |
| Paddles broader ; tuft on the 8th segment well developed | 5 |
| 5. Long fringe on the paddles | <i>S. africana.</i> |
| Short fringe on the paddles | 6 |
| 6. Paddles with distinct notch | <i>S. simpsoni.</i> |
| Paddles without distinct notch | 7 |
| 7. Single seta on the 7th segment ; tuft on the 8th of subplumose
hairs | <i>S. apicoargentea.</i> |
| A single or usually a double seta on the 7th segment ; tuft on
the 8th with only one or two hairs subplumose | <i>S. fasciata.</i> |

The tufts and setae of *Stegomyia* are variable both in different individuals and on the two sides of the same pupa, so that it is necessary to examine more than a single specimen in those cases where these structures are used in differentiating the species.

We have not had an opportunity of examining the pupae of *S. suguens*, *S. africana*, and *S. apicoargentea* but have relied on the descriptions by Wesché for the differential points.

***Stegomyia luteocephala*, Newst.**

The paddles are oval and rather narrow, but not so narrow as those of *S. unilineata*, they have a long fringe and a highly chitinised midrib, and the terminal seta is well developed. There are tufts at the posterior angles of the 7th and 8th segments, those of the 8th segment being the larger. These tufts vary in size considerably, and those on the 7th segment may be reduced to stout bifid hairs in some specimens, but as a rule they are well developed on one or other side of the body. On the 8th segment there is a single simple hair internal to the tuft, but the segment is otherwise almost bare. All the other segments carry a number of small setae, especially at their posterior margins, which are mostly simple, although a few are bifid ; none of these hairs is conspicuously or strongly developed. The dendritic tufts on the first segment are not very strongly developed and have only a small number (about 7) of primary branches.

***Stegomyia metallica*, Edw. (fig. 3).**

The paddles are oval, with a short fringe, a well-developed midrib, and a long terminal seta. At the posterior angles of the 7th and 8th segments there are setae differentiated as tufts of subplumose hairs ; those on the 8th segment being small but definite tufts, those on the 7th being little more than strong double or triple branched hairs. The 8th segment is bare but for the tuft at each angle and a small simple hair internal to it. On the 7th segment there are, in addition to the tufts, a number of simple hairs, mostly situated on the posterior margin, and a pair of

triple hairs. The 6th segment has at each posterior angle a strong bifid seta, on its posterior margin a number of simple and one pair of bifid setae, and a few small hairs further forward. The 5th segment has a single stout hair at the posterior angle and a number of small hairs near the posterior margin, one of which is larger than the others. The setae on the 4th segment are similar to those of the 5th, but the long hair is more highly developed. On the posterior margin of the 3rd segment, in addition to small hairs, there are on each side of the mid line a double or triple

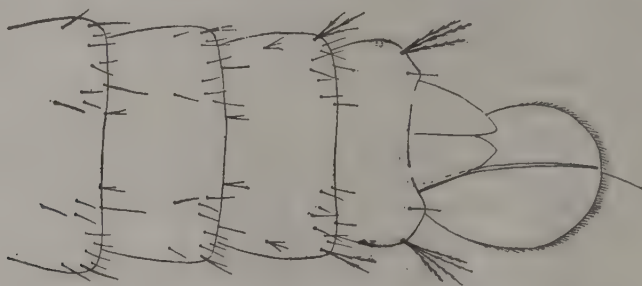


Fig. 3. *Stegomyia metallica*, Edw.

and a long simple seta. On the 2nd segment these setae are more highly developed and the inner one is composed of four branches. All these setae on the 2nd to the 8th segments are more highly chitinated and better developed than those of *S. luteocephala*. The dendritic setae on the 1st segment are well developed and have about a dozen primary divisions.

***Stegomyia simpsoni*, Theo.**

The paddles are broader than those of the two species just described and show a distinct notch at the point where the midrib ends; they have a slight fringe; the midrib is well-developed, and they carry the usual long terminal seta. On the 8th segment there is a small tuft at the posterior angle, some of the hairs of which are subplumose, and a single or bifid seta internal to it. The 7th segment bears a few quite small setae, mostly at its posterior margin, and at the posterior angle two larger setae, one of which is larger and stronger and is situated a little anterior to the other. The 6th segment shows similar hairs and one strong seta a little above the posterior angle. On the 5th segment the small hairs are mostly bifid and sometimes triple, the strong seta above the posterior angle is present, and in addition there is a long, strong seta on the posterior margin a little internal to the angle. The 4th segment bears similar hairs, but the strong seta above the posterior angle is smaller, and the long seta internal to the angle is more highly developed. On the 3rd segment the seta above the posterior angle is reduced still more, and on the posterior margin internal to the angle there is a small tuft and then a seta of moderate size. On the 2nd segment there are a few simple and divided hairs, none of which is specially developed. The dendritic hairs on the 1st segment are well-developed and show more than a dozen (about 16) primary divisions.

***Stegomyia unilineata*, Theo. (fig. 4).**

The paddles are narrower than is usual in the other members of this genus, the ratio of length to breadth being on the average as 1.6 is to 1; they have a stout midrib, a well developed fringe, and a long terminal seta. The abdominal setae are very variable in this species both in different individuals and on the two sides of the same specimen. The 8th segment is almost bare but carries at each posterior angle a stout seta, and internal to it a small hair. The seta at the posterior angle is well developed and may be single, double, or composed of three or four elements: it is subplumose. At the posterior angles of the 6th and 7th segments there are similar stout setae, but anterior to this there is little or no differentiation of the setae in this position. The seta at the posterior angle of the 7th segment is pubescent and may be single or double, that on the 6th segment is much smaller, simple, and either single or bifid. All the segments from the 2nd to the 7th bear numerous setae, the majority of which are situated on the posterior margins. Most of these

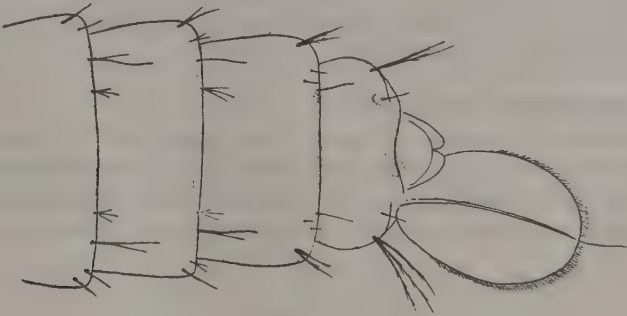


Fig. 4. *Stegomyia unilineata*, Theo.

setae are small, but two series are rather more highly developed. The one series is situated on the posterior margins about half-way between the mid line and the posterior angles and is represented by a long, single seta on the 6th and 7th segments, a long single or double seta on the 4th and 5th segments, and a long single seta on the 2nd and 3rd segments. The second series lies slightly internal to the first, and the setae composing it are developed into tufts, which gradually become smaller as the posterior extremity is approached. On the 2nd segment the tufts are usually well developed, on the 3rd and 4th they are smaller and consist of only four or five hairs, on the 5th and 6th they are reduced to triple hairs, and on the 7th they are represented by single or double hairs not specially differentiated from the other small setae on the segment. The dendritic setae on the 1st segment are well developed and have a large number (over a dozen) of primary divisions.

The above description is based on the examination of five pelts of pupae of this species.

Genus *OCHLEROTATUS*, Arrib.

- | | | | |
|--|----|----|------------------------|
| 1. Two small dark spots on the margin of each paddle | .. | .. | <i>O. sudanensis</i> . |
| No such spots | .. | .. | 2 |
- (C365) F

2. Single seta at the posterior angle of the 8th segment	<i>O. domesticus.</i>
Tuft on the 8th segment	3
3. Tuft on the 8th segment long, half the length of the paddle or more	4
Tuft on the 8th segment short, less than half the length of the paddle	5
4. Paddles with a fringe and a single long terminal seta	<i>O. apicoannulatus.</i>
Paddles without a fringe, short bifid terminal seta	<i>O. simulans.</i>
5. (Paddle plates "run at sharper curve from the ribs")	<i>O. nigricephalus.</i>
Paddles of usual shape	6
6. Paddles with a fringe	<i>O. albocephalus.</i>
Paddles without a fringe	<i>O. minutus,</i> <i>O. punctothoracis,</i> <i>O. caliginosus.</i>

This table is given with considerable diffidence, as we have ourselves examined only two of the species. Bacot figures three, namely, *O. simulans*, *O. apicoannulatus* and *O. minutus*, *O. sudanensis* was briefly mentioned by us in a previous paper (Bull. Ent. Res. vii, p. 7), and the others were described by Wesché. *O. albocephalus*, Theo., has not previously been described, or figured.

***Ochlerotatus albocephalus*, Theo (fig. 5).**

The paddles are oval in shape and show a well marked midrib, a slight external thickening or buttress, a slight but distinct external fringe, and a long terminal seta. The terminal seta is one-fifth the length of the midrib and in this respect resembles that of *O. minutus* as figured by Bacot. The 8th segment bears at each posterior

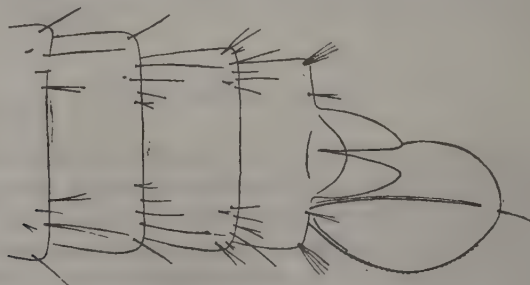


Fig. 5. *Ochlerotatus albocephalus*, Theo.

angle a small tuft of about four simple or pubescent hairs, which is just about the same length as the terminal seta on the paddle, namely, one-fifth the length of the midrib. Internal to the tuft, close to the outer margin of the paddle there is a long, slender, single or bifid hair. At the posterior angle of the 7th segment there is a bifid seta and a few small hairs, and along the posterior margin of the segment are a number of delicate and rather long hairs. On the 4th, 5th and 6th segments one of the setae on the posterior margin and a little internal to the angle is especially developed, so that it reaches right across the following segment. This seta may be single or double. The dendritic setae on the 1st segment are well developed. On the 2nd segment there is also a pair of dendritic setae, which are, however, much smaller than those on the 1st segment and but poorly chitinised.

Genus MANSONIOIDES, Theo.

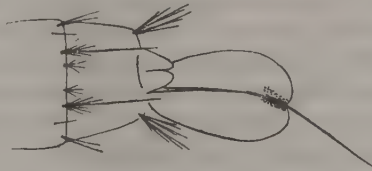
The early stages of *Mansonioides uniformis* are not known. The pupa of *M. africanus* can readily be distinguished from all other known West African pupae by the structure of the trumpet, which is developed at its distal end into a spine suitable for piercing the roots of the water-weed *Pistia stratiotes*, but it can also be separated from pupae of other genera of the tribe CULICINI by the characters of the paddles alone.

The structure of the paddles has been figured by Ingram (Bull. Ent. Res. iii, p. 377) and it is only necessary here to add that the ends are slightly thickened and that apparently there are no terminal setae. At the posterior angles of the 7th and 8th segments there are large single setae in place of tufts.

Genus AËDOMYIA, Theo.

Aëdomyia africana, N.L. (fig. 6).

The paddles are pyriform, slightly notched, and without a fringe; the outer margin is a little thickened and the midrib is well developed. There is a single stout terminal seta at the end of the paddle about as long as the paddle itself. In the middle line and at the distal end there is a slightly darkened patch.

Fig. 6. *Aëdomyia africana*, N.L.

The tufts at the posterior angles of the 8th segments are well developed and consist of four branched hairs. On the 7th segment there is a stout double seta at the posterior angle, and internal to it another tuft formed by the branching of a stout seta the median element of which is extremely long. Similar long tufts, or more correctly dendritic setae, are also present on the 4th to the 6th abdominal segments. Internal to these, and in a similar position on the 1st, 2nd and 3rd segments also, there is a tuft of slender hairs. The dorsal tuft on the 1st abdominal segment is poorly developed.

There are several tufts on the thorax, one of which lies just behind the trumpets and another at the posterior margin. The trumpets are not very long, but are highly chitinised.

Genus CULEX, L.

- | | |
|---|---|
| 1. Tuft at the posterior angle of the 8th segment containing | |
| branched hairs | 2 |
| Tuft on the 8th segment of subplumose hairs | 7 |
| 2. Tuft at the posterior angle of the 7th segment containing | |
| branched hairs | 3 |
| Tuft on the 7th segment of subplumose or simple hairs | 5 |

- | | |
|--|--|
| 3. Infuscated spot on the paddles | <i>C. quasigelidus.</i> |
| No such spot | 4 |
| 4. A triple hair at the posterior angle of the 5th and 6th segments | <i>C. thalassius.</i> |
| A tuft of five or six hairs at the posterior angle of the 5th and 6th segments | <i>C. tritaeniorhynchus.</i> |
| 5. Large species; length of the paddle about 0.9 mm. (70 units) | <i>C. tigripes</i> var. <i>fuscus.</i> |
| Small or medium-sized species | 6 |
| 6. Stout pupa, well chitinated; tubal aperture large (19 units to a trumpet length of 42 units) | <i>C. fatigans.</i> |
| Slender pupa, poorly chitinated; tubal aperture smaller (10 units to a trumpet length of 35 units) | <i>C. invidiosus.</i> |
| 7. Tuft on the 8th segment long, more than half the length of the paddle (19 to 34); trumpets short | <i>Cyathomyia fusca.</i> |
| Tuft on the 8th segment shorter, less than half the length of the paddle (8:42); a pair of long hairs on the distal margin of the 6th segment; trumpets larger | <i>C. guarti.</i> |

In drawing up this table it has been necessary to take into account certain minute characters which unfortunately has made it impossible to include some of the species described and figured by Wesché in insufficient detail. It has also been necessary to re-describe *C. fatigans* and *C. invidiosus* in order to bring out these points. The branched or subplumose character of the hairs composing the tufts at the posterior angles of the 7th and 8th segments is not a very satisfactory differential feature and has been adopted in the table only because it was employed by Wesché. Four of the species have not previously been described.

It may be noted as a point of possibly generic importance that none of the species of *Culex* that we have examined has had a fringe on the pupal paddles.

Culex fatigans, Wied. (fig. 7).

The pupa is stout and well chitinated. The paddles are large and slightly pyriform, with a well developed midrib and a slight thickening of the external border, but without a fringe. At the distal end of the midrib there are two small setae situated close together, the one being rather longer than the other. At the posterior angle of the 8th segment there is a tuft of about 6 to 8 branched hairs. At the posterior angle of the 7th segment there is a group of three setae; the one nearest the angle is a small tuft of 4 or 5 delicate hairs, just above it is a larger tuft of 3 to 5 stout hairs, which are usually subplumose but may be branched, and internal to this seta and a little above it is a small double or triple hair. Several other hairs are situated along the posterior margin of this segment, most of which are small and double, but one particularly long single hair may be found near the angle. The 6th segment bears just above its posterior angle a long delicate triple hair, on the posterior margin a little internal to the angle a very long double hair, and just internal to this a tuft of 4 hairs. Similar setae occur on the 5th segment, but the tuft internal to the angle is composed of rather more hairs, 5 usually. On the 4th segment the long lateral seta is sometimes double,

sometimes quadruple and the tuft internal to it comprises 5 to 7 hairs. On the 3rd segment there is a tuft of 7 or more hairs on the posterior margin a little internal to the angle. There are only a few small setae at the posterior angle of the 2nd, 3rd,

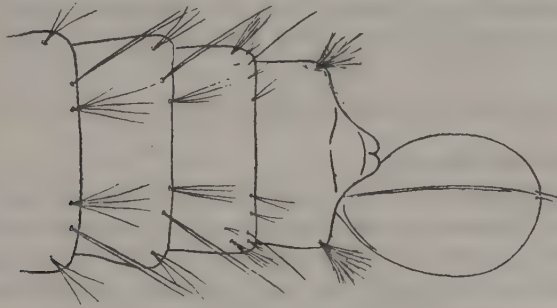


Fig. 7. *Culex fatigans*, Wied.

and 4th segments. The dendritic setae on the 1st segment are well developed, there is also a pair of small dendritic setae on the 2nd segment. The pupal trumpets are relatively short, but have a large aperture.

***Culex invidiosus*, Theo. (fig. 8).**

The paddles are similar to those of *C. fatigans*, that is, they are pyriform and have a well developed midrib, a slight external thickening, but no fringe. At the free end of each midrib are two small setae, set close together, one of which is a little larger than the other. The pupa is, however, much more delicate than that of *C. fatigans* and

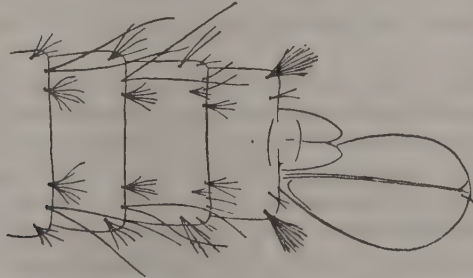


Fig. 8. *Culex invidiosus*, Theo.

is but poorly chitinised. The 8th segment bears a tuft at its posterior angle, and a delicate double hair close to the insertion of the paddle. The tuft is composed of 7 to 9 branched hairs. There are several delicate setae near the posterior angle of the 7th segment the most conspicuous of which is a tuft composed of 2 to 4 hairs, which may be either simple or subplumose. This tuft lies a little above the angle and close to the lateral margin of the abdomen. On the posterior margin of this segment and about half way between the angle and the mid line, there is a delicate tuft of about 4 hairs. The 6th segment has a delicate tuft of about 5 hairs in the posterior angle, an extremely long double seta on the posterior margin a little internal to the angle,

and internal to this a tuft of about 7 delicate hairs. The 5th segment bears similar setae to those on the 6th segment. On the posterior margin of the 4th segment there are two tufts a little internal to the angle, the outer composed of about 6 hairs and the inner of about 10. On the 3rd segment there are two similar tufts, the outer one of which is however much reduced. On the 2nd segment there are two delicate dendritic setae with long peduncles. The dendritic setae on the 1st segment are well developed.

The pupal trumpets have a smaller aperture than those of *C. fatigans*.

***Culex thalassius*, Theo. (fig. 9).**

The paddles are broad, with a well marked midrib, and an external thickening, but without a fringe. There are two small terminal setae, the larger of which is sometimes bifid. On the 8th segment there is a large tuft of 10 to 12 branched hairs at the posterior angle, and a small double hair near the external root of the paddle. On the 7th segment there is a small tuft of about 7 delicate hairs close to the posterior angle,

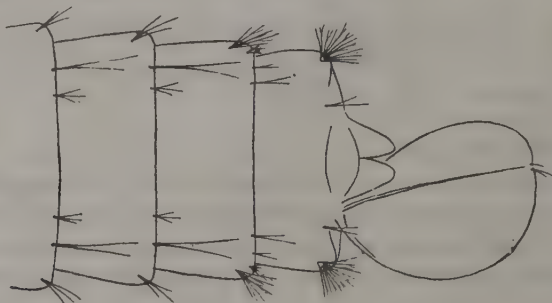


Fig. 9. *Culex thalassius*, Theo.

and a little above this a larger tuft of 4 to 6 stout branched setae. On the 6th segment there is at the posterior angle a delicate triple or double hair, but the most conspicuous seta lies a little internal to this on the posterior margin, and is long, strong, bifid, and pubescent or subplumose. The setae on the 5th segment are similar to those on the 6th. On the 4th segment the seta at the posterior angle is sub-divided into a tuft of about 5 delicate hairs, and the conspicuous seta internal to it is sometimes triple. On the 3rd segment the tuft near the posterior angle consists of about 6 elements, but the stout seta internal to it is no longer conspicuous. On the 2nd segment there is a small dendritic seta. The dendritic seta on the 1st segment is large and shows about 8 primary divisions.

***Culex tritaeniorhynchus*, Giles. (fig. 10).**

The pupal paddles are similar to those of *C. thalassius*; they are without a marginal fringe, and their terminal setae are paired but very small. The more conspicuous abdominal setae are as follows. On the 8th segment there is a lateral tuft of about 6 branched hairs. On the 7th segment there is a minute tuft in the posterior angle and just above it a larger tuft of 4 branched setae, and on the posterior margin about half-way between the angle and the mid line there is a tuft of 4 hairs. On the 4th,

5th, and 6th segments there is at the posterior angle a tuft of 5 or 6 hairs; just internal to this a stout double seta, which is not so well developed as in *C. thalassius*; and again internal to this and on the posterior margin a tuft of 6 to 8 hairs. The latter tuft is larger on the 4th and 5th segments than it is on the 6th, but on the 3rd segment

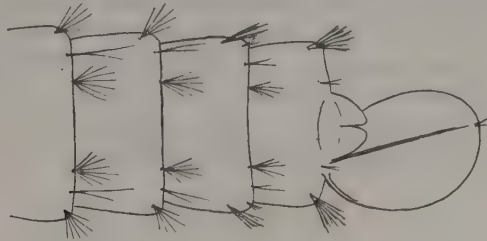


Fig. 10. *Culex tritaeniorhynchus*, Giles.

there is a similar tuft which is rather larger than that on the 4th segment. On the 2nd segment there is a small dendritic tuft. The dendritic tufts on the 1st segment are well developed and have about a dozen primary branches.

***Culex guiarti*, Blanch. (fig. 11).**

The pupa as a whole is very poorly chitinised. The paddles show no marginal fringe; they have paired small and slender terminal setae. Most of the abdominal setae are poorly chitinised, the only conspicuous ones being the lateral tufts on the 7th and 8th segments, and the very long double setae on the 5th and 6th segments. Near the posterior angle of the 8th segment there is a tuft of 7 or 8 subplumose hairs; this tuft is small, being less than a quarter the length of the midrib. In a similar

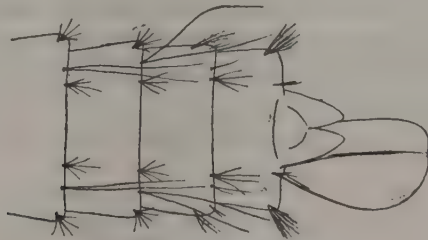
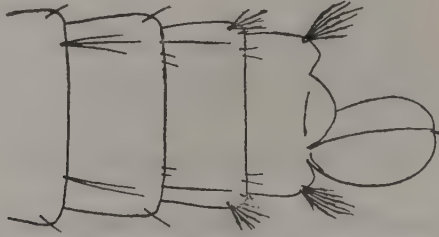


Fig. 11. *Culex guiarti*, Blanch.

position on the 7th segment there is a tuft of 3 or 4 subplumose hairs, and on the more anterior segments delicate tufts of about 5 fine hairs. On the posterior margin a little internal to the angle there is on the 5th and 6th segments a strong double or triple seta of great length; in a similar position on the 4th segment there is a tuft of 5 hairs. A little internal to these setae there are delicate tufts on the 3rd to the 7th segments. The dendritic setae on the 1st segment are large and much branched. The trumpets are long, poorly chitinised, and have a narrow aperture.

Genus *CYATHOMYIA*, Theo.***Cyathomyia fusca*, Theo. (fig. 12).**

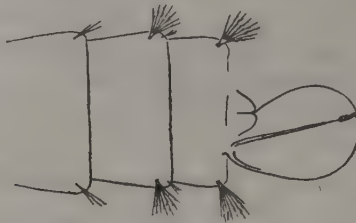
The paddles are rather small, with a slight external thickening, a midrib, but no fringe; they carry paired terminal setae, which are small and very delicate. On the 7th and 8th segments there are conspicuous lateral tufts; those on the 8th segment are long and are composed of 7 subplumose hairs, those on the 7th of 4 or 5 hairs, subplumose towards their extremities and branched at their tips. No such tufts

Fig. 12. *Cyathomyia fusca*, Theo.

are present on the other segments, which carry at their posterior angles only a few minute setae. On the posterior margins of the 4th, 5th and 6th segments there is a specially large seta a little less than half-way between the angle and the mid-line; this seta is single on the 6th segment and double or triple on the 4th and 5th. The trumpets are short, highly chitinated and with a moderately wide aperture.

Genus *EUMELANOMYIA*, Theo.***Eumelanomyia inconspicua*, Theo. (fig. 13).**

The pupa of this mosquito possesses pear-shaped paddles with a distinct external buttress; the midrib is well formed and has a peculiar expansion at its end; no terminal seta was visible in the single specimen examined. At the posterior angle of the 8th abdominal segment there is a fan-shaped tuft of 8 subplumose hairs; near

Fig. 13. *Eumelanomyia inconspicua*, Theo.

the posterior angle of the 7th segment there is a fan-shaped tuft of 7 less well developed subplumose hairs, but actually nearer the posterior angle there is a slender triple hair; near the posterior angle of the 6th segment there is a slender triple hair. The trumpets are rather long and narrow, slightly expanded at the ends and with small apertures. The whole pupa is dark and strongly chitinated.

Genus *MIMOMYIA*, Theo.

Edwards in his "Revised Keys to the Known Larvae of African Culicinae" has given a table by means of which the pupae of *M. splendens*, *M. plumosa*, *M. mimomyiaformis*, and *M. hispida* can be distinguished. In the following notes we give certain additional points of importance with regard to two of these species.

Mimomyia mimomyiaformis, Newst (fig. 14).

The pupa as a whole is dark, and the paddles and the middle parts of the abdominal segments are covered by minute spines. The paddles are pyriform, the inner distal angle, however, is characteristically squared; they are infuscated with a white

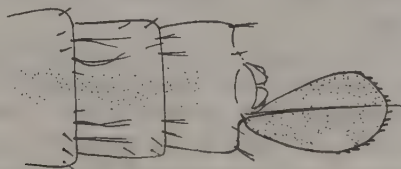


Fig. 14. *Mimomyia mimomyiaformis*, Newst.

comma-shaped marking on their outer sides; there is a fringe of large sparsely scattered points; the midrib is well developed, and there are single short terminal setae. The tufts at the posterior angles of the 8th segment are very small and consist of only 2 or 3 short hairs. On the 7th segment there are only a few minute setae near the posterior angle, and on the posterior margin a little internal to these two rather larger bifid setae. The latter setae are better developed on the anterior segments, and are further subdivided. The dendritic setae on the 1st segment are poorly developed and but little branched. The trumpets are long and pale at the tips.

Mimomyia splendens, Theo. (fig. 15).

The paddles are narrow, ending in a small knob-like projection, and slightly darkened at the tips. There is a well developed buttress both on the inner and outer margins of the paddles, but the midrib is poorly developed distally. The fringe on the paddles is long. The terminal setae are small, and there is a small seta close to

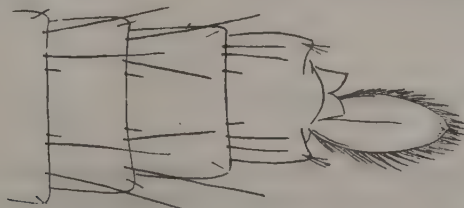


Fig. 15. *Mimomyia splendens*, Theo.

the midrib a little distance from the end. The tuft at the posterior angle of the 8th segment is poorly developed and consists of only one or two short hairs; the posterior angle itself is almost tooth-shaped. At the posterior angle of the 7th segment

there are only a few minute hairs. On the 2nd to 7th segments there are on each side two long powerful setae on the posterior margin a little internal to the angle, and a small stout seta internal to them; these setae are more highly developed on the anterior segments, and on the 7th segment may be poorly represented. The dendritic setae on the 1st segment are small and sparsely branched. The trumpets are long and pale for the apical third, but the actual end is somewhat darkened.

Genus URANOTAENIA, Attrib.

The only species of this genus that we have examined is *U. balfouri*. The paddles are peculiar in shape, as described by Wesché, that is the plates on the inner sides of the midribs are larger than those on the outer sides, an arrangement we have not observed in any other pupae.

The paddles of *U. balfouri* appear to be more pointed at the apex than those of *U. ornata*, which has been figured by Bacot, and the pupa differs also in having a fan-shaped tuft of simple hairs near to, but not actually at the posterior angle of the 7th abdominal segment, and the small tufts at the posterior angles of the 8th segment composed of only two hairs. In the specimen of *U. balfouri* examined by us there was also a dark ring at the base of the paddles.

Sub-family CHAOBORINAE.

Genus CHAOBORUS, Lichtenstein.

Chaoborus ceratopogones, Theo. (figs. 16, 17).

The pupa is less curved than the pupae of the CULICINAE. It has very large paddles of a peculiar shape; these paddles have a well developed buttress on their inner side and their internal margins are fringed, the midrib is broad and lies nearer the inner

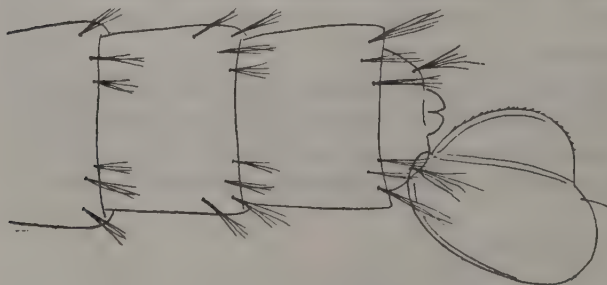


Fig 16. *Chaoborus ceratopogones*, Theo.

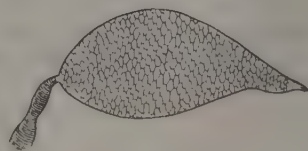


Fig. 17. Pupal trumpet of *Chaoborus ceratopogones*, $\times 75$.

than the outer side of the paddle, the inner lobe being thus narrower than the outer. There is a single slender terminal hair at some distance to the outer side of the end of the midrib. The pupa seems to be devoid of stout hairs, but there are delicate tufts near the posterior angles of all the segments and along the posterior margins. These tufts might easily be overlooked. The trumpets bear but a slight resemblance to the trumpets of the CULICINAE; they are flask-shaped or pear-shaped, with the narrow end outwardly directed: their surface is beautifully reticulated, suggesting an

alveolar-structured organ possibly functioning as a primitive lung; the trumpets have an exceedingly narrow slit-like opening distally and the proximal ends are connected with well marked tracheae, which narrow at their junction with the trumpets and become broader and more convoluted as they are traced into the interior of the pupal case. Miall (Aquatic Insects, p. 119) states that "The pupa floats in an upright position at the surface of the water." This statement is incorrect so far as the pupa of *Chaoborus ceratopogones* is concerned, as it appeared to spend the whole of its time at the bottom of the water in the glass vessel wherein it was placed.

The pupal stage lasted about 36 hours in the two specimens bred.

In conclusion, we desire to express our thanks to Dr. Guy A. K. Marshall, Director of the Imperial Bureau of Entomology, for his kind assistance in determining several of the species here dealt with; and to Miss Rhodes for the great care and trouble she has taken in the preparation of the illustrations.

NOTES RELATIVE TO THE IMPORTATION OF *TIPHIA PARALLELA*,
SMITH, FROM BARBADOS TO MAURITIUS FOR THE CONTROL
OF *PHYTALUS SMITHI*, ARROW.

By D. D'EMMEREZ DE CHARMOY,
Government Entomologist, Mauritius.

The existence in Mauritius of the Melolonthid beetle, *Phytalus smithi*, Arrow, was detected for the first time in July 1911 on those lands of Mon Rocher Estate which adjoin the Royal Botanical Gardens of Pamplemousses. It was at once suspected that this new pest of the sugar-cane must have been conveyed into the Colony by some shipment or other of sugar-cane cuttings from abroad, but no clue could be found as to its country of origin until February 1912, when it was detected in Barbados by Mr. Guy A. K. Marshall, Director of the Imperial Bureau of Entomology, who was then on his way to the Agricultural Conference held at Trinidad in that year.

The first results of the campaign against the insect were recorded in a report published by the Government of Mauritius in 1912. The methods therein prescribed for combating the pest are those that are still employed and consist mainly in :—

(1) Digging out larvae by means of hoes from those fields which show an average infection of 15,000 to 20,000 larvae and over per arpent. This operation is as a rule carried out during the months of May to September and is extended to October in very exceptional cases, for by this time of the year most of the larvae have burrowed deep into the ground for their ultimate transformation.

(2) Capturing adult insects at night from 7 to 9 p.m., which is carried out during the months of November to April and sometimes until June.

The annexed statements show the months of greatest emergence of the adult insects, the number of insects destroyed from July 1911 to June 1916, and the annual expenditure incurred.

It will be noticed that a considerable reduction in the number of insects has taken place in that zone which was at first most heavily infested, thus showing the possibility of effectively bringing the pest under control wherever, as at Mon Rocher, the prescribed measures are carried out with persistence and energy.

From the accompanying sketch map (see page 96) it will also be seen that the insects, though not increasing in numbers, have steadily gained ground during the last five years, the radius of the infected zone being now greater by one kilometre. The quarantine measures, however, that were imposed from the very beginning of the outbreak have succeeded in localising the pest within the limits of the District of Pamplemousses and in preventing its spread throughout the Colony.

As soon as the origin of the pest was ascertained, suggestions were made relative to the introduction of its natural enemies, which it was presumed might exist in the country of origin. Mr. Marshall during his stay in Barbados having ascertained that the insect, although distributed throughout that island, did not cause any serious

Table showing the Number of Beetles and Larvae of Phytalus smithi destroyed in the Pamplémousses District from July 1911 to June 1916.

	1911-1912.		1912-1913.		1913-1914.		1914-1915.		1915-1916.	
	Larvae.	Beetles.	Larvae.	Beetles.	Larvae.	Beetles.	Larvae.	Beetles.	Larvae.	Beetles.
Mon Rocher	553,666	9,928,152	211,818	3,222,067	187,045	4,987,939	347,200	3,367,321	9,300	1,423,963
Mount	106,147	10,153,414	—	5,777,385	1,824,300	20,577,423	6,164,100	18,341,588	1,023,300	10,529,973
Beau Plan	—	4,869,262	—	2,609,867	—	5,434,888	570,050	11,819,986	2,610,000	12,612,720
Small Planters and Esperance	257,125	1,509,359	—	4,436,217	25,150	5,483,880	183,700	17,827,512	3,012,500	18,560,927
Petite Rosalie, Grande Rosalie and Souvenir ..	1,938	—	—	—	—	—	—	999	39,750	117,546
Total Number of Insects	919,876	26,460,187	211,818	16,045,536	2,036,495	36,484,130	7,265,050	51,357,406	6,694,850	43,245,129

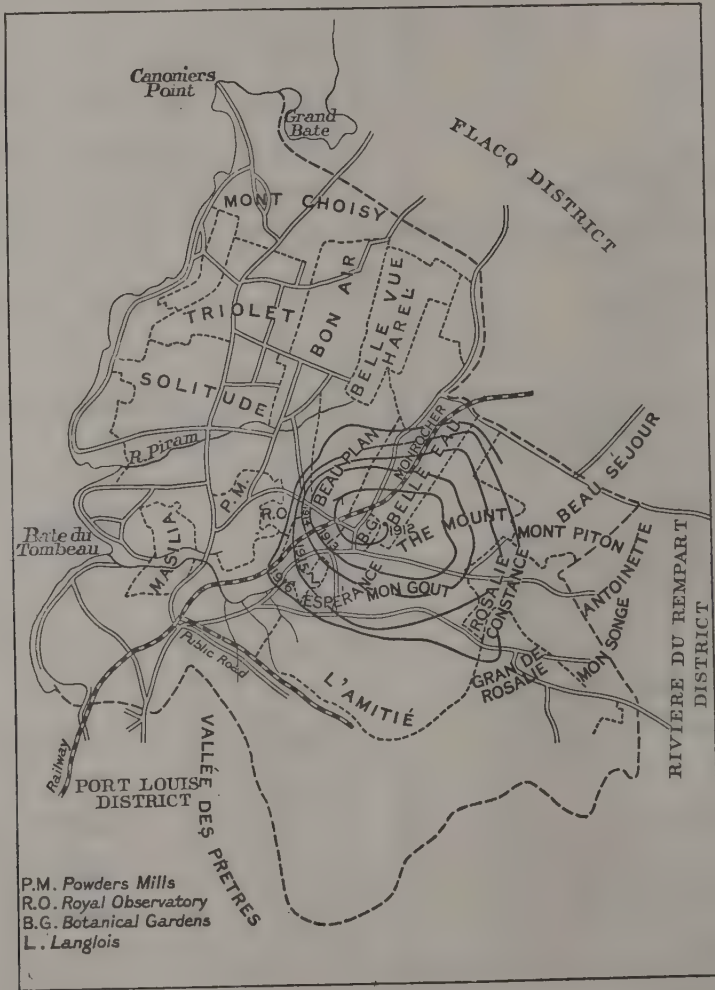
Table showing the Total Numbers of Phytalus smithi destroyed in the Pamplemousses District from 1911 to 1916, with the Cost.

	Total.		Amount Spent.	
	Larvae.	Beetles.	Rs.	Cs.
Mon Rocher	1,309,029	22,929,442	18,041	15
Mount	9,117,847	65,379,783	31,920	88
Beau Plan	3,180,050	24,734,003	17,282	74
Small Planters and Esperance	3,478,475	47,817,895	21,824	15
Petite Rosalie Grande Rosalie and Souvenir	41,688	118,545	193	13
Total Number of Insects	17,127,089	160,979,668	89,262	05

Table showing the Number of Larvae and Beetles of Phytalus smithi captured at Mon Rocher during the Year 1914-15.

	Larvae.	Beetles.
July	330,700	—
August	11,200	40
September	—	30
October	5,000	3,150
November	—	48,017
December	—	2,286,757
January	—	74,110
February	—	636,830
March	—	246,910
April	—	38,262
May	300	31,395
June	—	1,820
Total	347,200	3,367,321

damage to crops such as it did in Mauritius, at once concluded that it was being kept in check by some natural enemy. Upon *Phytalus* larvae which he brought back to the British Museum, Mr. Gilbert Arrow detected the presence of the larva of a Scoliid wasp, suspected of being that of *Dielis* (*Campsomeris*) *dorsata*, which Mr. Marshall had observed in fields infested with *Phytalus* and *Ligyrrus tumulosus*.



Sketch map in which the spiral black line shows the gradual increase in the distribution of *Phytalus smithi* during the past five years.

This fact led them to believe that this Scoliid might be one of the chief parasites that kept the *Phytalus* in check. It has since been shown, however, by Mr. W. Nowell, then Mycologist to the Local Department of Agriculture, Barbados, in a report published in the *Annals of Applied Biology* (1915) that the ratio of this parasitism to that due to *Tiphia parallela* at the same time and place was calculated to be

about one to a hundred. Mr. Nowell further states that towards the end of 1911 a large number of cocoons had been found by him in cane-fields infested with white grubs, which cocoons were identified as being those of *Tiphia parallela*, the existence of which had already been recorded in Brazil.

At about the same time the writer of this article recommended that enquiries be made from the Government of Barbados as to the natural enemies of the *Phytalus* with a view to their introduction into Mauritius.

From the labels attached to the specimens existing in the British Museum previous to its discovery in Mauritius, it was supposed that *Phytalus smithi* was indigenous to Trinidad. It was only in 1912 (March) that the nature of one of its enemies was indicated to the writer by Mr. Gilbert Arrow, and soon after definitely identified by Messrs. Bovell and Nowell of the Agricultural Department of Barbados, as *Tiphia parallela*.

The Government of Barbados was at once approached with a view to obtaining a few of these valuable insects and arrangements were kindly made by Mr. John R. Bovell, Superintendent of Agriculture, for the despatch of several shipments of *Tiphias* to Mauritius under different conditions from April 1913 to August 1915 as follows:—

(1) 2nd April 1913.—First consignment shipped from Barbados, a short time before the inauguration of the Department of Agriculture in Mauritius, and landed 26th June. It consisted of cocoons picked up in the fields and packed with some earth in a small wooden case. None of the cocoons hatched out.

(2) 8th July 1913.—Second consignment sent by parcel post, and reached Mauritius 15th August. This shipment too consisted of cocoons which did not hatch out.

(3) 25th June 1913.—Third shipment despatched, and arrived 15th August 1913. It consisted of four Wardian cases prepared under the care of Messrs. Bovell and Nowell and containing larvae of *Phytalus* and of *Tiphia* as follows:—

			Case No. 1.	No. 2.	No. 3.	No. 4.	Total.
<i>Tiphia</i> larvae	..	..	50	40	50	41	181
<i>Phytalus</i> larvae	..	..	190	160	180	120	650
<i>Tiphia</i> cocoons	..	..	170	—	—	—	170

The contents of these four cases were placed on the day of receipt in the Insectary at Pamplemousses, which had been amply stocked with *Phytalus* larvae of different stages during the previous six weeks.

As far as could be ascertained without breaking up the earth mass, these cases contained, besides 170 cocoons—31 of which had hatched out during the voyage, while the rest never hatched out—a fair number of cocoons in situ, numerous non-parasitised *Phytalus* larvae, five parasitised ones and two male *Tiphia*. From 15th to 28th August, one male emerged daily; from 28th August to 14th September none was found; and from the latter date to 2nd February 1914, a few insects of both sexes emerged daily, the greatest number in a single day being four males and two females on 29th November and six males on 9th December. As a rule these insects came out after 10 a.m. and buried themselves in the earth towards 3 p.m.

On 9th October the first parasitised larva was found, on the 20th a second, and a third on 11th February 1914. In April an examination of the Insectary was made and at the bottom were found but a few cocoons showing emergence holes.

The writer was absent from the Colony from October 1913 to March 1914 and was therefore unable to ascertain personally the number of insects that hatched out during that period ; but as his instructions were strictly complied with, he has good reasons to believe that these were very few and that the development of the insects in the Insectary was impaired by causes as yet to be determined.

With regard to this consignment there are a few facts that deserve to be noticed. Mr. Nowell had ascertained the probable egg capacity of a female to be about 70, and further that the insect can reproduce parthenogenetically. Supposing there were a minimum of 100 females in the cases out of 212 adult insects therein contained (181 originally introduced and 31 that hatched out from the cocoons en route), we see that 5,000 *Phytalus* larvae could have been parasitised by them, if we assume an average laying of 50 eggs per female *Tiphia*. As it was, the cases contained only 530 *Phytalus* larvae ; many of those that outlived the voyage were non-parasitised, and nearly a hundred *Phytalus* cocoons were found ; so that it is clear that the egg-laying power of the *Tiphia* had been considerably reduced under the prevailing conditions.

As the life-cycle of a *Tiphia* ranges, according to Mr. Nowell, between 50 and 60 days, it is evident that the two larvae found parasitised on arrival had been attacked by wasps of the second generation that emerged during the voyage ; and here again it is a matter of surprise that only two of the *Phytalus* larvae in the cases were parasitised.

There is, further, no room for doubt that the reproduction of the Tiphias was continued in the Insectarium up to the fourth generation, with a gradual reduction in the egg-laying power of the females.

(4) 10th June 1914.—Fourth consignment despatched, and reached Mauritius 15th August 1914. This shipment was made under the same conditions, but owing to the scarcity of adult Tiphias the cases were stocked with 29 cocoons and 32 adults only, while *Phytalus* larvae were placed therein to the number of 1,064.

Mr. Sydney Dash, Assistant Superintendent of Agriculture, Barbados, was able to ascertain that nearly 15 per cent. of the cocoons had hatched out and that a certain number of *Phytalus* larvae had already been parasitised before the despatch of the cases.

One of the cases was received in a soaked condition and from the three others 22 male and 10 female Tiphias were obtained. There were numerous non-parasitised larvae, just as in the previous shipment. These cases were left undisturbed, the insects as they emerged being removed and placed in the Insectary so as to allow of the exact number of emergences being known.

Hatching began on the 4th September and continued up to 24th January 1915, when 3 males were found ; 5 females and 10 males hatched out in September, 2 males and 1 female in October, 7 males and 1 female in November, and 3 males in January, or a total of 32 insects, which constituted the 3rd generation of the 58 adult insects that emerged in May 1914, not taking into account the 4th case that was flooded.

As already stated, the adult insects were transferred from the cases to the Insectary as soon as they hatched out ; by 20th November, however, no parasitised larva could be found (so far as could be ascertained without disturbing the insectaries), and it was decided to set free some insects. Two couples were therefore liberated at Mon Rocher to the east of the Botanical Gardens ; two further couples escaped from the Wardian cases on being transferred to the Insectaries and flew away to the west of the Gardens.

(5) The fifth consignment was despatched on 18th June 1915, and reached Mauritius on 25th August ; it consisted of cocoons spun in the case. After the parasitising of the *Phytalus* larvae had taken place in Barbados, the case, which had been fitted with four small feet, was closed exactly at the level of the contained earth, thus guarding both the earth and cocoons from being moved about. The case travelled *via* Southampton in the cold storage hold of steamers as far as Durban, but from the latter place to Mauritius it had to be transhipped and was placed directly upon ice blocks, which caused the death of the *Phytalus* larvae and the *Tiphia* pupae in the cocoons. On arrival there were found only fifty cocoons that had been spun *in situ*, that is to say, a number far inferior to that originally placed in the case.

The recurrence of the same facts on three different occasions, and the ever-increasing difficulties that were experienced in obtaining new shipments from Barbados, induced the Department of Agriculture to consider the question of obtaining another closely allied species from a nearer source than Barbados. This question was carefully gone into and the Chamber of Agriculture passed a resolution to the effect that steps should be taken for the introduction of *Tiphia bisinuata* from Madagascar ; and in the meanwhile, in case this attempt should not prove successful, that more effective measures be taken to secure further shipments of *Tiphia parallela* from Barbados or Brazil under the best possible conditions.

In view of a great reduction in the number of *Phytalus* to be found at Mon Rocher, very careful and thorough searches were made amongst the larvae. Not only was a large percentage of larvae found to be affected with bacterial or cryptogamic diseases, but also during this search parasitised larvae came to light. Two parasitised larvae were detected on the 8th and 9th May 1916 in the very field where Tiphias had been liberated in 1915, and by the 26th of the same month 7 other parasitised larvae had been found in various fields that were somewhat distant from each other. The first adult Tiphias were met with on the 23rd of the same month on Herbe Condé (*Cordia interrupta*) in the immediate vicinity of the field where *Tiphia* larvae had been found, and some days later 6 females and 10 males were found at Esperance. In the month of July parasitised larvae and adult Tiphias were found in greater numbers, more than 40 adults being met with in one instance on a single plant of Herbe Condé. In the following months they were found less frequently and became scarce in September and October.

The presence of parasitised larvae in the very field where adult Tiphias had been liberated 6 months previously left no doubt as to their origin, as well as that of those found elsewhere, *i.e.*, on the leeward side of the Botanical Gardens, in which direction those adults had flown that escaped from the Wardian cases as before stated.

In view of the number of the adult insects (40) met with at one time on a single shrub of *Cordia interrupta* and the area over which they spread, it may safely be concluded that there existed several hundreds of adult couples scattered over a surface of about 400 to 500 arpents. This fact is a clear proof of the influence exercised by a state of captivity upon the longevity and egg-laying power of certain species.

At this stage, a question naturally arises which it would be difficult to answer for the present. Granted that four couples were able to generate such a large number of insects within a period of 8 months, and that these insects became scattered over such a large area, how is it that in the same locality and under apparently similar conditions a much greater number of couples could not, on two different occasions, increase to a proportional extent? At first sight one can only ascribe this to their having been kept in captivity; and with a view to investigating the different effects that may be produced by such unnatural conditions, we shall here briefly review the observations we were able to make both as regards *Tiphia parallela* and *Elis rufa*, a species of Scoliid peculiar to the Mascarene Islands.

It is known that captivity brings about a state of sterility in certain vertebrates, and that this sterility may be temporary or permanent, according as certain conditions are temporarily or permanently absent. Captivity entails restricted space, deficient nest-material and, it may be, deficient food and unsuitable temperature; and it may well be responsible for the sterility and lesser vitality of certain animals.

As regards *Tiphia*, climatic conditions may be excluded, as they were the same for both captive and free insects; nesting-materials may also be set aside, as they consisted of *Phytalus* larvae, which in the Insectaries were available in greater numbers and were of easier access. Insufficient space does not appear to be a check on fertility, because from unfertilised (parthenogenetic) females that were kept in such small vessels as flower-pots Nowell succeeded in obtaining fertile eggs. Furthermore, reproductions, although on a considerably reduced scale, actually took place in Wardian cases and in the Insectary at Pamplémousses. It is possible, however, that insufficient space, which necessarily impedes the movements of insects, coupled with the absence of direct solar rays, may have a certain bearing on their longevity, if not on their fertility.

It will be seen further on that the egg-laying habits of *Tiphia* and *Elis* are such as to necessitate a sufficient length of time to allow of all eggs being laid; and it may be as well to mention here certain facts which may somehow account for the considerably reduced fertility of *Tiphias* when in a captive state.

The writer of this article, whilst studying the life-history of *Elis rufa*, had been struck by the invariable number of parasitised larvae or cocoons met with in cane-stools infested by *Lachnosterna*. Whatever the number of larvae found in a stool, there were hardly ever more than two—exceptionally three—parasitised larvae or cocoons to be found; if larvae, they were of the same age; if cocoons, they hatched at a few days' interval. In captivity it was observed that larvae were parasitised by twos and at intervals varying from 6 to 8 days. The same observations were recorded in the case of *Phytalus* larvae parasitised in open fields by *Tiphia*.

Examinations of the ovaries of several female *Elis* showed that the eggs could only

be laid in this manner owing to their different degrees of development; for in no case could more than two eggs be found in the same stage of development; namely one in the right oviduct and one in the left; and furthermore the interval between one laying and the next is explained by the marked difference in the sizes of the successive eggs in the ovaries.

The following observations will confirm this statement:

On 21st June two female *Tiphias* were captured at Esperance and placed in the Insectary at Pamplemousses together with numerous *Phytalus* larvae and were fed on honey and water. On 26th June a hundred of the larvae were examined and one of them was found to be parasitised. On 10th July three other larvae were parasitised; on the 17th two, and on the 27th three; or a total of 9 eggs laid by two female *Tiphias* during a period of more than one month. On 5th August two other females were submitted to the same conditions and by the 12th August had parasitised five larvae. It is quite possible that some other parasitised larvae had burrowed too deep in the soil to be found, but it is clear from what precedes that *Tiphia* and *Elis* lay their eggs only by twos, and exceptionally three at a time, and that an interval of at least seven days takes place between one laying and the next in captivity.

It may be well to add that none of these eggs hatched out; and furthermore Nowell states that he could never obtain more than six eggs from one captured female.

It would seem therefore that it is the longevity of the insect that is affected by captivity rather than its egg-laying power, and we are then led to enquire whether the food question does not play here an important rôle.

Nowell has observed that in Barbados *Tiphias* when in a free state lived on the secretions of Aphids, and that when in captivity they willingly fed on sugary liquids and on honey, but that neither in the captive nor in the free state did they resort to flowers for their food. The writer, who had made the same observations, was therefore afraid that it would be difficult to establish them at Pamplemousses for lack of proper food material, seeing that the few existing species of Aphids appear only at a certain time of the year and are then rapidly destroyed by Syrphids, Braconids, Coccinellids and fungi.

Now it is a noteworthy fact that *Tiphias* have established themselves at Pamplemousses and have made good the scarcity of plant-lice by having recourse to the sweetish content of the vesicular hairs of *Cordia interrupta*. This plant is a native of British Guiana, which was introduced about 15 years ago; it is now a regular pest and infests all uncultivated fields.

This unexpected change of diet might at first sight lead one to believe that the quality of the food is immaterial to these insects, and it had no evil influence on the captive ones. A closer observation of other facts, however, leads to a different opinion; namely, that this change of diet was the result of a deliberate choice, most probably due to the constituents of the vesicular hair content of *Cordia interrupta* being more closely related to the secretion of Aphids than to the nectar of flowers. It is indeed well known that ants are as a rule very fond of the secretions of Aphids, while they are only exceptionally met with on flowers. The red ants of Pamplemousses (*Solenopsis* sp. ?) show a peculiar liking for the secretions of Coccids and are

found in great numbers on trees infested with *Icerya seychellarum*, Westwood. Now these ants sometimes occur in such large numbers on leaves of Herbe Condé that one might believe this plant to be infested with Aphids, the belief being strengthened by the fact that the ants circle round a central spot, just as if they were surrounding an Aphid or a Coccid. This further tends to prove the similarity that apparently exists between the secretions of the Aphids and the sweetish content of the vesicular hairs of *Cordia interrupta*.

It would be premature to conclude from the preceding observations that the quality of the food was chiefly responsible for the attempts at *Tiphia* importation having been nearly a failure, as there may exist other causes which more systematic searches might bring to light.

The writer's aim in recording these observations and in trying to interpret them was to point out the difficulties experienced in introducing insects from a long distance and the necessity of a closer study of the food requirements of the economic species utilised by mankind as auxiliaries.

The importation of *Tiphias* and their establishment in Mauritius have brought to light several interesting facts which may serve as guides in the future for the introduction into other countries of species of the same family.

It is the pleasant duty of the writer to avail himself of this opportunity for acknowledging the valuable assistance received from all those who contributed to this importation. To Mr. John R. Bovell, Superintendent of Agriculture, Barbados, and his assistants, Messrs. W. Nowell and J. Sydney Dash; to Dr. Guy A. K. Marshall, Director of the Imperial Bureau of Entomology; to Mr. C. P. Lounsbury, Chief of the Division of Entomology of the Union of South Africa; and to Mr. C. W. Mally, Entomologist of the Cape Province, are due the grateful thanks of the planters of this Colony for their untiring efforts in securing the importation into Mauritius of this valuable parasite.

[Since the foregoing paper was received Mr. d'Emmerez has written to say that at that time (5th May 1917) specimens of *Tiphia parallela* were to be found in thousands on *Cordia interrupta* all over Esperance Estate and Maison Blanche. He estimated the females on the plants at about 5%, but was not certain whether this was due to the earlier emergence of the males, or to the fact that the majority of the females were engaged in oviposition underground. He states that in his insectary the females have laid fertile eggs on larvae of *Adoretus versutus*, and on young larvae of *Oryctes*.—ED.]

NOTES ON THE COCCIDAE OF BRITISH GUIANA.*

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The object of this paper is to supplement an article which appeared early in 1914 in the Journal of the Board of Agriculture of British Guiana (Vol. iii, No. 3.) At that time it was proposed to publish a further account of these insects as soon as more species had been collected and identified, and fuller information gained. Also, taking into consideration the great economic importance of the COCCIDAE, it has been deemed advisable to disseminate as widely as possible all information which has been acquired concerning them locally. In the previous article, some fifty-one species were enumerated and notes recorded concerning their habits and economic importance. In this paper information appertaining to sixty-eight species is given, a number of which are new to science. Further knowledge with regard to the parasites and predaceous enemies has been gained, as well as their economic status.

The following short account of previous work on the COCCIDAE of British Guiana is of interest. Their study may be said to have commenced in 1888 when a number of common species of Coccids were collected in the Botanic Gardens, Georgetown, and forwarded to Mr. J. S. McIntire, of Shepherds Bush, London. These species were examined both by this gentleman and also Mr. J. W. Douglas, and the results of their studies were published in the Entomologists Monthly Magazine, the Journal of the Quekett Microscopical Club, and in two papers published in Timehri, the Journal of the Royal Agricultural and Commercial Society of British Guiana, the one written and illustrated by Mr. McIntire and the other by Mr. R. Ward.

Between the years 1888-1894 a series of articles dealing with Guiana COCCIDAE appeared in the Entomologists Monthly Magazine, written by Mr. J. W. Douglas, Mr. A. C. F. Morgan, Professor R. Newstead and Mr. E. E. Green. The material on which these articles were based was collected in the botanic Gardens, Georgetown, by Mr. G. S. Jenman, F.L.S. Thus some twenty-two species of scales were described either for the first time or identified as previously described species.

During more recent years, with the exception of a small but interesting collection made by Mr. A. W. Bartlett, who was Government Botanist for some years, no further work has been done on the COCCIDAE of this part of Tropical America.

The collection of COCCIDAE in this laboratory was commenced by the writer in 1911 and may now be said to be very fairly representative. Collections have been made in all the various cultivated parts of the Colony, and species have been obtained from many of the wild and uninhabited portions. I have to thank the following gentlemen who from time to time have forwarded interesting specimens, Mr. R. Ward, Mr. L. D. Cleare Jnr., Mr. P. M. de Weever, Mr. A. A. Abraham, Mr. E. M. Morgan, and Mr. H. W. Moore. The determinations have been made in most cases through the agency of the Imperial Bureau of Entomology by Professor Robert Newstead, F.R.S., the well-known authority on COCCIDAE. With the exception of

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a few species, either dried or microscopical preparations, and in many cases both, are preserved in this laboratory.

For the sake of convenience the classification adhered to throughout the paper is that adopted by Mrs. Fernald in her well-known catalogue.

In British Guiana, as elsewhere, scale-insects are among the worst insect enemies with which agriculturists have to deal. The cost of their annual depredations must be enormous, yet little is done by the smaller farmer in the way of controlling them. Systematic spraying is carried out on some of the large coconut estates with beneficial results.

The COCCINELLIDAE are among the most important enemies of scale-insects in this country and the following species have been observed and identified.

Pentilia insidiosa, Muls. Observed to be predaceous only on *Asterolecanium bambusae*, Bdv. It is a common species where this Coccid occurs; few bamboos are free from them.

Hyperaspis festiva, Muls. Predaceous on *Pseudococcus sacchari*, Ckll. Occurs commonly, being found beneath the leaf-sheaths of sugar-cane with the scale.

Hyperaspis orthopustulata, Muls. Another common enemy of *P. sacchari*, Ckll.

Brachyacantha 10-punctata, Melsh. Predaceous on a species of *Pseudococcus*. An uncommon species.

Neda dilychnis, Muls. Predaceous on *Aspidiotus destructor*, Sign. An uncommon species, but found in this one instance occurring in large numbers on a heavily infested coconut palm.

Cryptognatha nodiceps, Mshl. A common species preying on *A. destructor*, Sign.

Azya trinitatis, Mshl. Another common enemy of *A. destructor*, Sign.

Azya pontbrianti, Muls. Frequently occurs as an enemy of *Saissetia hemisphaerica*, Targ.

The Chrysopid, *Chrysopa claveri*, Navas, is occasionally found as a predaceous enemy of the sugar-cane mealy bug (*Pseudococcus sacchari*, Ckll.).

The following Hymenopterous parasites have been bred from COCCIDAE at various times. Considerable difficulty has been experienced in obtaining identifications. A large number of species still await determination.

Arrhenophagus chionaspidis, Auriv., bred from *Hemichionaspis minor*, Mask.

Leptomastix dactylopii, Howard, bred from *Pseudococcus citri*, Risso.

Lecaniobius cockerelli, Ashm., bred from *Saissetia nigra*, Nietn.

Three species of coccophagous Lepidopterous larvae occasionally occur, namely *Blastobasis lecaniella*, Busck (BLASTOBASIDAE), *Vitula bodkini*, Dyar (PYRALIDAE) and *Vitula toboga*, Dyar (PYRALIDAE). These three species attack indiscriminately the following Coccids: *Saissetia nigra*, Nietn., *Saissetia oleae*, Bern., *Saissetia hemisphaerica*, Targ., and *Ceroplastes floridensis*, Comstock.

Two species of entomogenous fungi are at times found attacking colonies of scale-insects. Both species are well known elsewhere in the West Indies. They are the red-headed fungus (*Sphaerostilbe coccophila*, Tul.) and the shield-scale fungus (*Cephalosporium lecanii*). The red-headed fungus principally attacks *Chionaspis citri*, Comstock; while the shield-scale fungus attacks such Coccids as *Saissetia*

nigra, Nietn., *Saissetia oleae*, Bern., *Saissetia hemisphaerica*, Targ., *Coccus mangiferae*, Green, *Coccus hesperidum*, Linn., and *Coccus viridis*, Green.

Both of these fungi are more effective in the interior districts, where a more humid climate prevails. On the coast lands they are only operative during the rainy season.

The following species of ants have been observed to attend certain species of COCCIDAE.

<i>Daceton armigerum</i> , Latr.	<i>P. citri</i> , Risso, on cacao pods.
<i>Cryptocerus atratus</i> , L.	<i>P. citri</i> , Risso, <i>Coccus hesperidum</i> , Linn., <i>Saissetia nigra</i> , Nietn.
<i>Cryptocerus minutus</i> , F.	<i>Pulvinaria pyriformis</i> , Ckll., <i>Coccus hesperidum</i> , Linn.
<i>Ectatoma tuberculatum</i> , Oliv.	<i>Saissetia nigra</i> , Nietn., on Hibiscus.
<i>Tetramorium guineense</i> , F.	<i>Pseudococcus sacchari</i> , Newst., on sugar-cane; <i>P. citri</i> , Risso, on cacao pods.
<i>Azteca schimperi</i> , Em.	<i>Lecanium aequale</i> , Newst., on Courida; <i>Cero-</i> <i>plastes avicenniae</i> , Newst., on Courida.
<i>Dolichoderus</i> (<i>Hypoclinea</i>) <i>bidens</i> , L.	<i>Pseudococcus citri</i> , Risso, on cacao pods.
<i>Solenopsis pylades</i> , Forel.	<i>Pseudococcus sacchari</i> , Newst.
A species of <i>Cremastogaster</i> fosters <i>Akermes quinquepori</i> , Newst.	

Family COCCIDAE.

Subfamily MONOPHLEBINAE.

Llaveia abrahami, Newst. A rare species. First observed by Mr. A. A. Abraham at the Government Experimental Station, Issororo, N.W.D. It was only found in this instance in an indentation of the bark of the native rubber tree, *Sapium jenmani*.

Subfamily DIASPINAE.

Chionaspis citri, Comstock. A very common species; to be found on the bark of most species of citrus trees and also on the castor oil plant.

Howardia biclavis, Comst. Fairly common on the branches of jasmine (*Jasminum* sp.).

Howardia biclavis detecta, Mask. A very uncommon form. Only once collected on the branches and twigs of the native rubber tree, *Sapium jenmani*.

Diaspis boisduvali, Signoret. Occasionally found on the stem of plantains. Common on the leaves of some orchids, especially the Cattleyas.

Diaspis echinocacti opuntiae, Ckll. Recorded in 1893 from British Guiana by T. D. A. Cockerell and in 1889 by Newstead. I have personally never collected this species in the Colony.

Aulacaspis rosae, Bouché. Very common on the leaves of mango trees; also found on cinnamon (*Laurus cinnamomum*). The males are always more conspicuous.

Hemichionaspis minor, Mask. Fairly common on cultivated cotton and also on a species of wild ipecacuanha.

Pinnaspis buxi, Bouché. Common on a number of ornamental plants and also on garden plants.

Aspidiotus cydoniae, Comstock. Occasionally occurs on the stem of the egg-plant (*Solanum melongena*).

Aspidiotus destructor, Signoret. The commonest and most destructive Coccid in British Guiana. Occurs on a large variety of cultivated and wild plants. Its commonest cultivated host-plants are the coconut palm, plantains (*Musa paradisaica*), bananas (*Musa sapientum*) and avocado pear tree (*Persea gratissima*).

Aspidiotus diffinis, Newstead. Recorded from British Guiana in 1893 by R. Newstead as a new species. It has not been collected here since.

Aspidiotus sacchari, Ckll. A common species, usually found on the stem of sugarcane just beneath the surface of the soil.

Aspidiotus rapax, Comst. An uncommon species. Up to the present only found on the twigs of the Oronoque tree (*Erythrina glauca*). Professor Newstead remarked on examining this species. "The ♀♀ in this colony have remarkably malformed squamae; I thought it new at first, but am of the opinion that the organs in question are in some way diseased, they are so inconstant."

Morganella longispina, Morgan. Recorded from British Guiana by A. C. F. Morgan in 1889; careful search has failed to reveal its presence since.

Pseudonidia fossor, Newst. An uncommon species; only once collected on the twigs and branches of a large Muscatel grape-vine in Georgetown.

Selenaspidus articulatus, Morgan. Occurs commonly on all varieties of citrus plants and also on the leaves of Liberian coffee (*Coffea liberica*).

Chrysomphalus aonidium, Linn. Not a common species. Occurs on the leaves of citrus plants.

Chrysomphalus aurantii, Mask. A very occasional species on citrus plants.

Chrysomphalus biformis, Ckll. Of frequent occurrence on most orchids, especially *Schomburgkia crispa*, and also on sisal plants (*Agave rigida* var. *sisalana*).

Chrysomphalus dictyospermi, Morgan. Recorded from British Guiana in 1889 by A. C. F. Morgan. It has not been collected since.

Chrysomphalus dictyospermi pinnulifera, Mask. Recorded from British Guiana in 1892 by Maskell as occurring on crotons (*Codiaeum* spp.). Not observed since.

Chrysomphalus dictyospermi arecae, Newst. Recorded from British Guiana by Newstead in 1893. Not found here since.

Chrysomphalus personatus, Comstock. A common species. Occurs on leaves of star apple (*Chrysophyllum cainito*), many ornamental palms, mangoes, and also on the leaves of Para rubber trees (*Hevea brasiliensis*).

Chrysomphalus erythraspidis, Newst. A comparatively rare species. Collected once on the twigs of the Oronoque tree (*Erythrina glauca*). It was found in abundance in this particular instance.

Lepidosaphes beckii, Newm. One of the most widely distributed and commonest species of Coccids in the Colony. Citrus plants, crotons, Barbados cherry (*Malpighia glabra*) are a few of its common host-plants.

Lepidosaphes pinnaeformis, Bouché. Recorded from British Guiana in 1892 by Maskell. It has not been taken here since.

Ischnaspis longirostris, Sign. Commonly occurs on mango (*Mangifera indica*), Liberian coffee, and many species of ornamental palms.

Parlatoria ziziphus, Lucas. To be found at times on citrus plants, though it is not a common species.

Subfamily ORTHEZIINAE.

Orthezia insignis, Douglas. An exceedingly injurious and common species. Found on a large variety of plants, chiefly belonging to the order Compositae. This and the following species are well-known garden pests, especially in Georgetown.

Orthezia praelonga, Douglas. Commonly infests a number of plants such as crotons, mangoes, Barbados cherry, etc.; it has also been known to attack sugar-cane and a species of rubber tree (*Sapium jenmani*).

Subfamily DACTYLOPIINAE.

Asterolecanium bambusae, Bdv. The ordinary species of bamboo are seldom without this Coccid. It is widely distributed over the Colony.

Asterolecanium fimbriatum, Fonsc. Recorded from British Guiana in 1889 by Morgan on leaves of *Cupania sapida*. I have been quite unable to find this species despite a vigorous search.

Asterolecanium pustulans, Ckll. A not uncommon Coccid on the leaves of some orchids and the akee (*Blighia sapida*). On several occasions I have observed it on the twigs of *Hevea brasiliensis*, where it was causing considerable damage.

Lecaniodiaspis dendrobii, Douglas. Recorded from British Guiana by Douglas in 1892. I have not been able to find this species on the host-plant mentioned by Douglas.

Pseudococcus citri, Risso. Of frequent occurrence on citrus plants, cacao, ferns, crotons, occasionally on rice plants and several species of grasses, rarely on sugar-cane.

Pseudococcus nipae, Mask. Recorded from British Guiana in 1893 by R. Newstead on coconut palms. Not a common species.

Pseudococcus virgatus, Ckll. On one occasion collected from the leaves of Boulanger or egg-plant. It occurs also on some garden plants, such as violets.

Pseudococcus sacchari, Ckll. The common sugar-cane mealy bug of British Guiana. Found wherever sugar-cane is grown. It is much more prevalent in dry weather, when it flourishes; wet weather causes it to be attacked by a green parasitic fungus which causes great mortality.

Subfamily TACHARDIINAE.

Tachardia lacca, Kerr. Collected here in 1890 by Robert Ward in the Botanic Gardens. I have not observed the species personally.

Tachardia bodkini, Newst. Collected on the twigs of a native rubber-producing tree, *Sapium jenmani*. A rare species.

Subfamily COCCINAE.

Pulvinaria pyriformis, Ckll. Of common occurrence on the leaves of guava (*Psidium guayava*), avocado (*Persea gratissima*) and a few species of ornamental plants.

Pulvinaria simulans, Ckll. Recorded some years ago by A. W. Bartlett. I have not collected the species myself.

Pulvinaria flavicans, Mask., var. *formicicola*, Newst. An uncommon species. Collected from a wild species of plant with a deep red sap, which has earned it the name of "blood-wood plant." This species was attended by a species of *Cremastogaster* ant.

Pulvinaria elongata, Newst. A rare species. Occurs on the leaf-blades of sugar-cane.

Ceroplastes denudatus, Ckll. Recorded in 1893 by Cockerell as occurring in British Guiana on crotons. It has been collected here recently on a species of wild Solanaceous plant. Professor Newstead remarks on examining this species "these are the first examples I have seen with the tests complete."

Ceroplastes dugesii, Towns. Recorded some years ago by A. W. Bartlett as occurring on *Schinus terebinthifolius*.

Ceroplastes floridensis, Comst. A common species, occurring especially on citrus plants and ferns.

Ceroplastes cirripediformis, Comst. An uncommon species, occurring on *Ipomoea* sp. in Georgetown.

Ceroplastes avicenniae, Newst. An uncommon species, occurring solely on the maritime plant known locally as Courida (*Avicennia nitida*).

Vinsonia stellifera, Westw. Recorded from British Guiana since 1888. An exceedingly common species on a great variety of plants, principally coconut, citrus plants, ornamental palms, and orchids. Occurs also on several species of wild plants found in the interior districts.

Eucalymnatus chelonoides, Newst. A rare species. Collected from leaves of *Pachira insignis* in the Botanic Gardens, Georgetown.

Eucalymnatus perforatus, Newst. Found only occasionally on the leaves of coconut (*Cocos nucifera*) and French cashew (*Eugenia jambolana*).

Eucalymnatus tessellatus, Sign. A common species on ornamental palms.

Coccus aequalis, Newst. A small species and common in certain districts on Courida (*Avicennia nitida*). Invariably associated with the species of ant mentioned previously; occasionally a species of *Cremastogaster* ant is found in attendance.

Coccus hesperidum, Linn. A common species, especially on citrus plants and Liberian coffee (*Coffea liberica*).

Coccus mangiferae, Green. Recorded from British Guiana since 1888. An exceedingly common species on the leaves of mango, also on jasmin (*Eugenia paniculata*).

Coccus viridis, Green. A common species on Liberian coffee in certain districts. Of considerable economic importance.

Coccus wardi, Newst. A rare species. From leaves of Malacca apple, Georgetown.

Akermes quinquepori, Newst. A rare species. From beneath the bark of certain trees. On this occasion taken from *Macrolobium acaciaefolium* in the Botanic Gardens, Georgetown. Never more than one or two are found together in one position. The species is invariably attended by a small black species of *Cremastogaster* ant. When alive it is of a dull pinkish colour closely adhering to the bark.

Coccus impar, Kll. An uncommon species. Name of host-plant unknown.

Saissetia begoniae, Douglas. Recorded from British Guiana in 1892 on *Begonia* sp. It has not been met with since then.

Saissetia hemisphaerica, Targ. An exceedingly common species. Its commonest host-plants are Liberian coffee, citrus plants, guava, and several species of ferns. Occasionally found on crotons.

Saissetia nigra, Nietn. The commonest species of *Saissetia* in British Guiana. Recorded since 1891. Host-plants: *Hevea brasiliensis*, *Sapium jenmani*, Okra (*Hibiscus esculentus*), *Solanum melongena*, and many others.

Saissetia oleae, Bern. A common species on citrus plants, crotons, *Duranta*, etc.

Saissetia hurae, Newst. A rare species. A thick infestation was however discovered on one occasion on the twigs of a sand-box tree (*Hura crepitans*), attended by a species of *Cremastogaster* ant.

Saissetia scutata, Newst. A rare species. A large colony was discovered in one instance on a cannon-ball tree (*Couroupita guianensis*). The infestation covered the curling branches which bear the flowers and fruit near the ground. A species of *Cremastogaster* ant was in attendance.

SOME INSECTS INJURIOUS TO CACAO PLANTS IN THE BELGIAN CONGO.

M. Raymond Mayné, the Government Entomologist in the Belgian Congo, has recently made a special study of the insects that live on cacao in that country, and the Belgian Ministry of Agriculture is shortly publishing his report on the subject. The material collected by him comprises a number of species new to science, some of which are described below by various specialists.

All the species dealt with were taken in the Mayumbe district, a region of dense tropical forest, not very far from the coast and lying due north of Boma.

Order COLEOPTERA.

Family MELOLONTHIDAE.

By GILBERT J. ARROW.

***Aserica variegata*, sp. nov.**

Ferruginea, subopaca, fronte, pronoti macula magna tripartita elytrorumque plagis tessellatis viridinigris; sat longe ovalis, corpore supra et subtus irregulariter albo-setoso, scutelli lateribus elytrorumque basi densius setosis, partibus obscuribus fere nudis, hic et illic dorso squamis nonnullis majoribus ornato; clypeo grosse et rugose punctato, antice leviter emarginato, fronte et pronoto parce punctatis, hujus lateribus leviter arcuatis, angulis anticis acutis, posticis rectis, elytris profunde striatis, intervallis convexis; pygidio parce punctato et setoso, linea mediana laevi; pedibus haud brevibus, tibiis anticis fortiter bidentatis, posticis modice latis.

♂, oculis magnis, clava antennali ad stipitem longitudine aequali.

Long., 6 mm.; lat. max., 3 mm.

This insect, according to M. Mayné, devours the young and tender leaves of the cacao. I have seen only a single pair. It is one of the group of species called *Lepiserica* by Brenske, but included in *Autoserica* by Péringuey, who has pointed out that no practical means of separating them has been devised. The latter name is also redundant, being synonymous with *Aserica*.

A. variegata is rather elongate in form and decorated like the species of *Euphoresia*, but without a sternal process. The elytra are deeply striated and the alternate intervals are decorated with greenish-black patches, almost bare of the setae with which the remaining surface is sprinkled. The posterior part of the head and the middle of the pronotum are also greenish-black, the latter dark area trilobed behind. In addition to the minute setae there are also broad scales upon the scutellum, in the intervals longitudinally dividing the dark patches upon the elytra, and a small cluster on each side of the middle of the pronotum.

***Pseudotrochilus concolor*, Kolbe.**

This is undoubtedly the insect so-called by Brenske, but the original description is quite inadequate for its certain identification. Its typical form has been well described by Gyllenhal (Schonherr's *Synonymia Insectorum*) under the incorrect name of *Melolontha versicolor*, F. It is remarkably variable in coloration, but normally red-brown, with narrow black margins and five vague black spots upon the

pronotum, frequently reduced to two placed at the base. The five spots may also coalesce and cover part or the whole of the pronotum, and the elytral border may extend from behind forwards to cover the whole hinder part of the elytra (var. *nigromaculatus*, Brenske), or there may be an intricate dark network. In one specimen the scutellum alone remains pale, in another this and a red spot on each side of the pronotum, and finally, the entire surface may become black.

***Triodonta procera*, Lansb.**

I think this is probably Lansberge's species, in spite of certain inaccordant phrases in the description. It is certainly not nitid and the hairy clothing of the lower surface is distinctly longer, instead of shorter, than that of the upper side, but these discrepancies may perhaps be due to hasty writing.

It is strange that the real significance of the remarkable modification of the mentum described by Lansberge has never been recognised. It is certainly not, as supposed by him, a possibly generic feature characteristic of a few of the species, but is distinctive of the males of nearly all. Like the equally remarkable claw-development in the same sex, it is a prehensile device, its essential feature being the backwardly-directed and extremely strong, close and regularly-arranged spines (generally cleft at the end) with which the enlarged mentum is provided on its outer face.

Family CURCULIONIDAE.

By Guy A. K. MARSHALL, D.Sc.

***Systates ramosus*, sp. nov. (fig. 1).**

Colour varying from black to red-brown, rather thinly and unevenly clothed with grey or buff scales so that the integument is largely exposed.

♂. *Head* dull and shagreened, the forehead almost flat and with a very short deep central furrow, the furrow separating off the rostrum strongly angulate in the middle; along the inner edge of the eye is a row of 5-7 erect flattened white setae. *Rostrum* longer than its basal width, sculptured like the forehead, tricarinate, the central carina rather more distinct than the others and bifid in front, the two lateral ones strongly convergent anteriorly, the sides of the rostrum not falling steeply below them, but forming a continuous transverse curve with the median area; this lateral convexity causes the scrobes to be more sharply delimited behind than usual; the genae broadly dilated. *Antennae* with the scape moderately stout, subcylindrical, of almost the same thickness throughout, slightly curved downwards only at the apical fourth, with rugose longitudinal wrinkles and clothed with subrecumbent broad dark setae and sparse pale scales; the funicle with joints 1 and 2 equal, 3 longer than 4, and 4 to 7 equal. *Prothorax* much broader than long, the sides strongly rounded, broadest well behind the middle, without any apical constriction, but markedly constricted at the base, which is not much broader than the apex, the latter being shallowly sinuate; the upper surface comparatively flat, finely shagreened, usually with a short bare smooth central line, and set with very small and widely separated granules, each bearing a short erect scale-like seta. *Elytra* ovate, broadest at about one-fourth from the base (being there obtusely angulated) and rapidly narrowing thence to the apex; the basal margin abruptly raised and forming a sharp transverse ridge, each external angle being produced obliquely forwards into a broad process, 1.2 mm. long, which is

broadly truncate at the apex, the external angle being extended downwards to a point, while the basal half of the process is dilated into a broadly triangular sharply pointed tooth, the greatest width of the process being 1 mm.; the upper surface with regular rows of large, bare and rather transverse punctures; the intervals scarcely broader than the punctures, smooth and shiny, and each bearing a row of long erect scale-like setae, which are deeply emarginate at the tip; the scales are small, convex, fluted and almost circular, the apical edge being somewhat flattened. *Legs* stout, without any long silky hairs; the front tibiae shallowly bisinuate internally

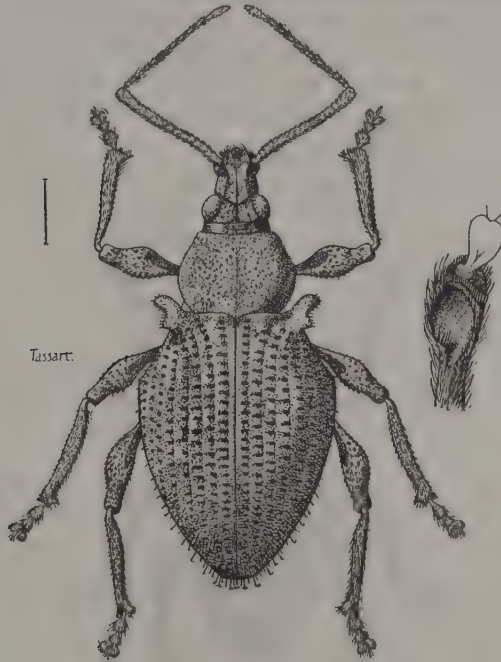


Fig. 1. *Systates ramosus*, sp. n., Mshl., ♂.

and having at the apex on the lower surface a broad deep cup-like cavity, the inner basal margin of which is produced into a short lobe bearing four stout spines, with two others above it; the mid tibiae with a shallow longitudinal impression on the lower surface at the apex with three short spines on its anterior edge; the hind tibiae not distorted, the inner surface smooth and flattened almost to the base, its lower edge with small denticulations.

Length, $7\frac{1}{2}$; breadth, $3\frac{1}{2}$ mm.

♀. Differs only as follows:—The elytra are broader and shorter, not nearly so much narrowed posteriorly, the dorsal outline being much more convex and steeper behind; the apical excavation on the front tibiae is much shallower, and the hind tibiae are not flattened internally, except narrowly in the apical third, both edges being distinctly denticulate.

Length, 6–7; breadth, $3\frac{1}{4}$ – $3\frac{1}{2}$ mm.

(C365)

This remarkable species may be readily recognised by the striking basal prominences on the elytra and the cup-like cavities on the front tibiae of the male.

This insect is stated by M. Mayné to occur but rarely, the adult attacking the leaves of full-grown trees.

***Systates maynei*, sp. nov. (fig. 2).**

Colour black, piceous or red-brown, thinly covered with small sub-circular convex fluted grey scales, often having a pale greenish or coppery reflexion.

♂. *Head* separated from the rostrum by an angulated furrow; the forehead almost flat, shiny and faintly alutaceous, with a deep central furrow, which is about equal to one-half the anterior furrow; along the inner orbit of each eye a row of 5-7 erect flattened pale setae. *Rostrum* longer than its basal width, gradually narrowing from the base to the middle and broadly dilated at the genae; the upper surface



Fig. 2. *Systates maynei*, Mshl., sp. n., ♂.

tricarinate, the median carina bifid at the apex, the outer ones strongly convergent in front; the lateral areas not perpendicular, but sloping gradually outwards, the upper portion of the scrobe being therefore sharply delimited behind by an oblique carina. *Antennae* as described for *S. ramosus*, except that joints 4 and 7 of the funicle are each slightly longer than 5 or 6. *Prothorax* a little broader than long (6:5), the sides rather strongly and regularly rounded, broadest about the middle, the apical margin truncate and only slightly narrower than the base; the upper surface, shagreened, usually with an abbreviated shiny central line, and set with sparse small granules, each bearing an erect scale-like seta. *Elytra* ovate, broadest not far from the base and gradually narrowing from there to the apex, the sides being quite straight from the base to the point of greatest width (above the middle of the metasternum);

the basal margin forming a low straight transverse carina, the outer angles of which are produced into a very short sharp point; the upper surface with rows of large bare transverse punctures, the intervals narrower than the punctures and hardly broader than the interspaces between them; each interval with a regular row of dark erect broad apically-emarginate setae. *Legs* stout and without long hairs; the anterior pairs of tibiae normal, shallowly bisinuate internally; the hind pair with the inner face strongly flattened in the apical half, its upper edge being there carinate and the lower edge finely denticulate, and the external apical angle not produced.

Length, $4\frac{3}{4}$ – $5\frac{1}{2}$; breadth, $2\frac{1}{4}$ – $2\frac{3}{4}$ mm.

♀. The elytra are much more rotund and less narrowed behind, and the very convex dorsal outline is steeper near the apex; the hind tibiae are not flattened internally and are more conspicuously denticulate.

Length, $4\frac{3}{4}$ – $5\frac{1}{2}$; breadth, $2\frac{3}{4}$ –3 mm.

In general form like a small specimen of *S. fossulatus*, Klb., which has the base of the elytra similarly constructed; but the latter species differs in the following respects:—the rostrum is gradually widened from base to apex, the outer dorsal carinae are almost parallel, the first joint of the funicle is distinctly longer than the second, the granules on the prothorax are much larger and shiny, all the tibiae of the ♂ are fringed beneath with long silky hairs, the outer apical angle of the hind pair is produced into a broad acute-angled process, etc.

This weevil is abundant in cacao plantations, being especially injurious to young plants in the nurseries. The injury is caused by the mature insect, which devours the leaves, eating large portions out of them along the edges. Nothing is known as to the early stages of this or the preceding species.

***Alcides theobromae*, sp. nov. (fig. 3).**

♀. Colour shiny black and almost bare above; the prothorax duller, with a transverse lateral band of pale recumbent hairs at the base and near the apex; the elytra with the following markings formed of similar hairs: a very small spot at the shoulder and near the base of interval 2, a spot on interval 4 a little before the middle, an irregular transverse row of spots behind the middle on intervals 2, 4, 6 and 8, and a patch in the pre-apical depression; the lower surface somewhat densely clothed with tawny feathered scales. The markings are evidently very easily abraded.

Head dull, finely aciculate on the vertex, the forehead with shallow confluent punctation and shallowly impressed between the eyes. *Rostrum* about as long as the front femur, moderately stout and almost straight, the dorsal outline straight for three-fourths the length and then sloping gently; the upper surface fairly closely punctured throughout, but less so towards the apex, and without any furrows or carinae, the punctures much larger and longitudinally confluent at the sides on the basal half. *Antennae* stout and black; the funicle with the two basal joints short, 1 longer and thicker than 2, 3–5 subequal and strongly transverse, 6 much longer than 5 and nearly quadrate, 7 hardly as long as the first two joints of the club, the first joint of which is bare and shiny on its basal half. *Prothorax* a trifle shorter than its basal width, broadest at the base, rather strongly narrowed in front, distinctly constricted near the apex, the sides moderately rounded; the dorsal outline very convex, the downward slope of the front half being much steeper than any part of the elytral

slope; the upper surface closely and evenly set with small low shiny granules of various sizes. *Scutellum* transverse, smooth and impunctate. *Elytra* broadest at the shoulders, where they are only slightly broader than the prothorax, and gradually narrowing from there to the apex; the dorsal outline rising very slightly from the base to one-fourth the length, then gradually sloping backwards and becoming steeper in the apical third; the basal lobes longitudinally wrinkled, and a shallow depression involving the bases of striae 1 and 2 behind the scutellum; the striae very shallow on the disk, rather deeper at the sides and apex, the punctures moderately large,



Fig. 3. *Alcides theobromae*, Mshl. sp. n., ♀.

their septa narrower than the intervals, which are smooth and shiny and bear very small scattered punctures, except on interval 1 and the juxta-apical area, which are rather rugosely punctate; a distinct epipleural carina from the hind coxae to the apex, the epipleurae being oblique in front, but quite horizontal at the apex and there bearing coarse confluent punctures. *Legs* moderately stout, all the tibiae with a sharp internal tooth near the apex, the front pair with a broad triangular tooth about the middle, which is represented by a feeble angulation on the middle pair. *Sternum*: the metasternum granulate and with a large prominence on each side in front of the hind coxae.

Length, 8; breadth, $3\frac{1}{2}$ mm.

Very closely allied to *A. cultrirostris*, Thoms., which differs in the following points: - The elytra are mahogany red, the tibiae lack the inner apical tooth, the anterior slope of the prothorax is less steep, and the punctures on the disk of the elytra are much larger, so that their septa are scarcely narrower than the intervals.

The larvae of this weevil bore longitudinal galleries in the small branches of cacao trees; the leaves subsequently turn yellow and the branch dies. The beetle is not as yet sufficiently numerous as to be regarded as an important pest.

Family LAMIIDAE.

By C. J. GAHAN, M.A., D.Sc.

Tragocephala maynei, sp. nov.

T. nobili (Fab.) affinis, sed differt capitis medio haud vittato, elytris prope basin non transversim fasciatis. Capite inter antennas sat lato fere plano, margine antica frontis genarumque et macula pone oculum coeruleis; prothorace utrinque ante tuberculum lateralem ochreo-fulvo fasciato, basi lateraliter coerulescente; elytris nigro-velutinis, utrisque maculis quatuor ochreo-fulvis notatis: macula prima ad latus paullo pone humerum, secunda transversa et tertia parva rotunda obliquiter positae pone medium, quarta transversa paullo ante apicem; macula infra humerum, puncta postero-laterali, et macula minuta ad suturam vix ante apicem coerulescentibus; corpore inferiore pedibusque coerulescentibus, nigro fasciatis et maculatis; antennis (♀) paullo pone medium elytrorum transeuntibus, scapo ad apicem angustim cicatricoso; prosterno sat lato, antice verticali et transversim truncato, mesosterno antice late rotundato; femoribus brevibus subclavatum incrassatis.

Long., 20; lat., 7 mm.

This species is nearly related to *Tragocephala nobilis*, Fab., with which it agrees in general form and structure, the only difference noticeable in this respect being the somewhat broader intercoxal process of the prosternum in the present species. It differs however in markings; the head is without a median band, the genae and front are bordered below with greyish blue pubescence and there is a patch of the same colour behind each eye; the prothorax is banded at the sides as in *T. nobilis*, but with the band in front of the lateral tubercle more ochreous or brownish in colour; the elytra are marked each with four ochreous tawny spots—one at the side a little behind the shoulder, two placed obliquely a little behind the middle, and the fourth transversely a little before the apex; each has, in addition, a bluish spot below the shoulder, a blue lateral speck at about one-fourth from the apex, and a speck on the suture just before the apex. Body beneath and legs glaucous blue, banded with black.

Exocentrus ortmansi, sp. nov.

Niger sat dense griseo-pubescent, antennis dense setosis quam corpore paullo longioribus, articulis ab 3° cinereo anguste annulatis; prothorace transverso, spinis lateralibus pone medium positae, retro directae; elytris nigro-setosis, setis in seriebus octo utrinque ordinatis, interstitiis bi- aut uni-seriatim sed haud regulariter punctatis, punctis post medium evanescentibus.

Long., 6; lat., 2.5 mm.

Black, with a rather dense covering of grey pubescence. Antennae a little longer than the body, black with a rather dense fringe of black setae beneath, the joints from the 3rd narrowly ringed with grey at the base. Prothorax with a few scattered black setae, lateral spine placed behind the middle, and directed towards the shoulder of the elytron. The elytra, seen in certain lights, exhibit a faint brownish band behind the middle; each has eight longitudinal series of black setae, and on the basal half the intervals between the rows of setae are punctured in rather irregular rows, the rows in some parts being double and in others, especially farther back from the base, single.

Order RHYNCHOTA.

By W. L. DISTANT.

Family COREIDAE.

***Pendulinus devastans*, sp. nov.**

Above with the head, pronotum, scutellum and corium ochraceous, thickly darkly punctate; narrow margins to the pronotum and scutellum and the margins and venation to corium pale ochraceous and impunctate; membrane shining bronzy-brown; body beneath and legs pale ochraceous; head beneath and sternum thickly but not darkly punctate, a small shining black spot on each side near outer margins of posterior coxae; tibiae sometimes moderately roseate in hue; antennae reddish-ochraceous, apical joint either paler in hue, or testaceous with the bases and apices paler, basal joint moderately thickened and a little curved outwardly, its apical area somewhat incrassate, first and second joints almost subequal in length, second and third joints slender, second longer than third, fourth incrassate, subequal in length to third; head above centrally longitudinally incised; lateral pronotal angles subprominent; venation of corium robust.

Long., 13; breadth between pronotal angles, 4 mm.

Immature forms.

1st stage.—Head and pronotum fuscous-brown; abdomen above more or less roseate in hue; body beneath and legs ochraceous; antennae strongly incrassate, the third joint distinctly dilated.

Long., 5–7 mm.

2nd stage.—Above more or less pale castaneous, on anterior and posterior margins of fourth abdominal segment, a small rounded protuberance each containing two small shining black tubercles, and another black tubercle on each side near the lateral margins of the segment; antennae as in first stage.

Long., 9 mm.

The perfect insect is allied to *P. carmelita*, Burm., from which it differs by the more robust and differently coloured antennae, absence of the black fasciate markings beneath, etc.*

* I add a description of another allied species found in Natal, which is probably also a destructive insect:—

***Pendulinus nigromarginatus*.**

Allied to *P. carmelita*, Burm. and *♂. devastans*, Dist., from both of which it differs in having the lateral margins of the pronotum and more than basal half of the sub-lateral margins of the corium, black; antennae ochraceous, basal joint stoutest and darkest, distinctly curved and considerably longer than the second joint, which with the third joint is slender, fourth joint mutilated; body beneath pale ochraceous; legs and rostrum dark ochraceous; other characters generally as in *P. devastans*.

Long., 11–12 mm.

Hab. Natal, near Durban (*Bell Marley*).

COLLECTIONS RECEIVED.

The following collections were received by the Imperial Bureau of Entomology between 1st January and 31st March, 1917, and the thanks of the Managing Committee are tendered to the contributors for their kind assistance :—

Dr. W. M. Aders :—386 Culicidae ; from Zanzibar.

Mr. G. E. Bodkin, Government Economic Biologist :—2 Culicidae, 5 other Diptera, 2 Siphonaptera, 31 Hymenoptera, 12 Coleoptera, 2 Trichoptera, 3 Mallophaga, 5 Rhynchota, 5 Orthoptera, 1 Mayfly, 1 Dragonfly, 9 Ticks, 1 tube of intestinal worms, 1 Centipede, 4 Scorpions, and 1 Spider ; from British Guiana.

Mr. J. R. Bovell, Superintendent of Agriculture :—2 Diptera, 4 Coleoptera, 3 Lepidoptera, 2 Rhynchota, 1 Cockroach, and 1 Spider ; from Barbados.

Mr. D'Emmerez de Charmoy, Government Entomologist :—98 Trypetidae and about 50 pupa-cases, and 3 other Diptera ; from Mauritius.

Mr. E. C. Chubb, Curator of the Durban Museum :—44 Culicidae, 2 Hippoboscidae, 187 other Diptera, and 65 Coleoptera ; from Natal.

Dr. J. B. Davey, Medical Officer :—68 Culicidae, 5 Tabanidae, 4 *Glossina*, 36 other Diptera, 23 Hymenoptera, 13 Coleoptera, 3 Planipennia, 4 Trichoptera, 2 Isoptera, 4 Mallophaga, 10 Rhynchota, 17 Orthoptera, 2 Odonata, 100 Ticks, 1 Centipede, 2 Scorpions, and 4 Entozoa ; from Nyasaland.

The Division of Entomology, Pretoria :—15 Diptera, 1 Moth, 14 Hymenoptera, 90 Coleoptera, 27 Rhynchota, and 1 Grasshopper ; from South Africa.

Mr. P. R. Dupont, Curator of the Botanic Station :—4 packages of Coccidae and fungi ; from Seychelles.

Mr. W. W. Froggatt, Government Entomologist, New South Wales :—126 Diptera, 32 Chalcidids, 6 other Hymenoptera, and 14 Coleoptera ; from various Australasian localities.

Mr. C. C. Gowdey, Government Entomologist :—3 Culicidae, 4 other Diptera, 2 Lepidoptera, 60 Chalcidids, 98 other Hymenoptera, 243 Coleoptera, 20 Thysanoptera, 6 packets of Coccidae, about 100 Aphididae, 117 other Rhynchota, and 17 Orthoptera ; from Uganda.

Mr. E. Hutchins, Chief Veterinary Officer :—1 *Tabanus* and 14 *Haematopota* ; from Uganda.

Mr. R. W. Jack, Government Entomologist :—8 Diptera and 13 Moths ; from Rhodesia.

Mr. F. P. Jepson, Government Entomologist :—About 100 Diptera ; from Fiji.

Mr. H. H. King, Government Entomologist, Anglo-Egyptian Sudan :—3 Ants ; from Khartoum.

Dr. W. A. Lamborn :—51 Tabanidae, 405 *Glossina*, 14 Hippoboscidae, 270 other Diptera, 1 Moth, about 80 Chalcidids, 117 other Hymenoptera, 52 Coleoptera, 4 Rhynchota, 4 Earwigs, 1 Stone-fly, 8 Ephemeroptera, and 2 Odonata ; from German East Africa.

Mr. S. Leefmans, Laboratorium von Plantenzeikten, Buitenzorg :—27 Coleoptera from Java.

Prof. R. Newstead, F.R.S. :—About 50 Ants, from Jamaica ; and 4 E. Chalcidids.

Capt. J. E. T. Phillips :—50 *Haematopota* ; from Uganda.

Dr. J. J. Simpson :—360 Tabanidae, 1,211 *Glossina*, 497 Hippoboscidae, 1,000 other Diptera, 338 Hymenoptera, 247 Coleoptera, 1,158 Rhynchota, 9 Odonata, and 3 Orthoptera ; from the Gold Coast.

Mr. R. Veitch :—38 Diptera, 1 Moth, 1 Caddis-fly, 20 Chalcidids, 21 other Hymenoptera, 47 Coleoptera, 3 Planipennia, 6 Rhynchota, 10 Orthoptera, 1 Dragonfly, 1 Arachnida, and 1 Centipede ; from Fiji.

Mr. C. B. Williams :—7 Tabanidae, 4 Hippoboscidae, 9 other Diptera, 1 flea, 1 Moth, 10 Chalcids, 235 other Hymenoptera, 60 Coleoptera, 5 Mallophaga, 106 Rhynchota, and a tube of Entozoa ; from British Guiana.

The Wellcome Bureau of Scientific Research :—2 Hymenoptera, 18 Coleoptera, 77 Lepidoptera, 2 Rhynchota, 7 Orthoptera, and 1 Dragonfly ; from Venezuela.

Mr. R. C. Wood :—14 Tabanidae, 1 Asilid and its prey, 132 Trypetidae, 1 Hymenoptera, 3 Coleoptera, and 3 Spiders ; from Nyasaland.

ON THE SUPPOSED FIRST STAGE LARVA OF LEPTOHYLEMYIA COARCTATA, FALL.

By D. KEILIN, D.Sc.

(From the Quick Laboratory, University of Cambridge.)

It has been well known since the studies of Taschenberg (1864–1872) that the larvae of *Leptohylemyia coarctata*, Fall., attack wheat and rye. The damage due to this fly has been observed many times in almost all European countries, and many papers have been devoted to its life-history. Of these papers the most important are those of E. Ormerod (1882–1895), S. Rostrup (1905–1911), T. Hedlund (1906–1907), P. Marchal (1909) and finally the recent work of Kurdjumov (1914).

We owe to Hedlund (quoted by Kurdjumov, p. 25) the most complete account of the development of this fly. According to this author, copulation takes place with this species at the beginning of July. The examination of the ovaria of females captured in the field at different times has led him to the conclusion that the deposition of eggs takes place between the 1st and 22nd of August. Hedlund has also observed that eggs of this fly, which were laid in earth in the breeding vessels at the beginning of August, contained in September a completely formed larva which in December had not yet hatched.

In this way it seems that he has been able to confirm the supposition of Ormerod and of Rostrup that *L. coarctata* has only one generation per annum; that it deposits its eggs towards the end of summer or at the beginning of the autumn; that the eggs, which are always laid in the earth, hibernate; and that the larvae do not hatch till the spring.

These results were accepted by Kurdjumov (1914) in his recent publication on this fly.* According to this author's personal observations the newly hatched females are never sexually mature and they pass the whole summer in this state of immaturity, so that oviposition takes place only at the beginning of the autumn. Kurdjumov's paper contains also the description and the figures of the egg and primary larva of *L. coarctata*. This is of special interest, because of all the life-history of this insect the part that is most disputed and the most difficult to observe, but which is of great economic importance, is precisely the beginning of the cycle, *i.e.*, the oviposition and the first-stage larva. From his description and figures it would seem that Kurdjumov produces definite data relating to the beginning of the cycle.

We shall now consider under what conditions this primary larva was discovered by Kurdjumov.

During the whole summer he kept in his breeding vessels both males and females of *L. coarctata*. On 28th August all the flies that he had bred were, with one exception, killed by a fungus. All the females which perished had undeveloped ovaries. The

* The reader is referred to this paper (in Russian) for full references and for a critical examination of many papers dealing with this insect. Kurdjumov, N.V.: *Adia genitalis*, Schnabl, and *Leptohylemyia coarctata*, Fall., Reports of the Agric. Exper. Station of Poltava, Branch of Agric. Entomol., 1914, No. 21, part ix., pp. 1–43. [Abstracted in Rev. Appl. Ent. ii, 1914, p. 3250.]

single female still living had a rounded abdomen, which showed that its ovaries were well developed. This female was put in another breeding vessel, and the dissection of this fly, done three days later, showed that its ovaries were perfectly matured. The breeding vessel (terrarium) was well examined: Kurdjumov found no eggs on the plants, but in the earth he found at no great depth two eggs similar to those discovered in the lower chambers of the ovary of the dissected fly. In one of these eggs the black mouth-parts of the larva were visible through the egg-covering.

On 9th November this egg was taken to the laboratory and on 12th November the larva protruded the anterior part of its body from the egg and died in this position. Kurdjumov inferred from the facts (a) that the frost did not kill the egg, and (b) that as the larva hatched as soon as it was transferred to a warm place, it is the egg which represents the hibernating stage of *L. coarctata*. He next describes the first stage larva; but his description, and especially his figure 26, convince me that neither eggs nor larva belong to the developmental cycle of *L. coarctata*.

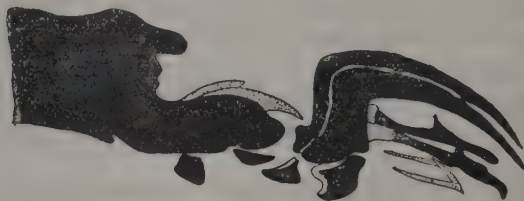


Fig. 1. Mouth-parts of Kurdjumov's primary larva.

It is quite sufficient to look at Kurdjumov's fig. 26, which I reproduce here (fig. 1), and which represents the mouth-parts of his primary larva, to establish from all the details of the structure he delineates that it pertains to a carnivorous larva.*

If we compare the mouth-parts of this supposed first-stage larva with those of a full-grown larva of *Leptohylemyia*, we can easily see that the difference is not one which we usually find between the primary and third stage larva of the same species. The difference is such as can only exist between two different ethological groups. As figure 2 shows, the mouth-parts of a full-grown *Leptohylemyia* larva are very like those of one of the phytophagous Anthomyid larvae (*Pegomyia nigratarsis*, or even those of *Adia genitalis*, discovered by Kurdjumov).† The first stage *Leptohylemyia* larva should be then very similar to the primary phytophagous larva and it probably resembles closely that of *Adia genitalis* (fig. 5 of Kurdjumov).

Kurdjumov's description contains two other points which show that his primary larva does not belong to *Leptohylemyia*, for he states: (1) that the last abdominal segment is round and without the protuberances which are very characteristic for the full-grown larva of *Leptohylemyia*; (2) that the posterior spiracles of his primary larva have three clefts and closely resemble those of a third stage cyclorrhaphous

* See: D. Keilin. Recherches sur les Anthomyides à larves carnivores. *Parasitology*, ix, no. 3.

† I am much indebted to Messrs. C. Warburton and F. R. Petherbridge for the larvae of *Leptohylemyia coarctata* herein referred to.

larva. This demonstrates the existence in this insect of development with almost obliterated trimorphism, such as characterises carnivorous Anthomyid larvae.

We may therefore conclude from (1) the structure of the mouth-parts, (2) the shape of the posterior end of the abdomen, and (3) the structure of the posterior spiracles,

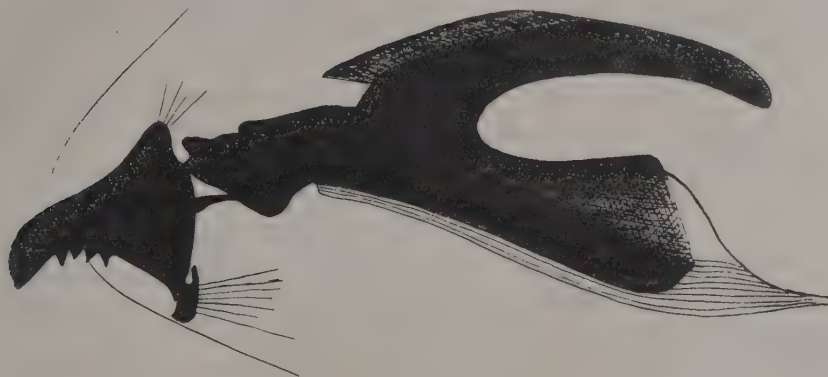


Fig. 2. Mouth-parts of a full-grown larva of *Leptohylemyia coarctata*.

that the primary larva found by Kurdjumov does not belong to the developmental cycle of *Leptohylemyia coarctata*, Fall. On the other hand it is quite easy to suppose that the two eggs found by Kurdjumov in his breeding vessel were brought in with the earth from outside.

OBSERVATIONS ON SCALE-INSECTS (COCCIDAE)—V.

By ROBERT NEWSTEAD, F.R.S.,

The School of Tropical Medicine, The University, Liverpool.

Aspidoproctus armatus, Newst.

PORTUGUESE CONGO: San Salvador; on tree of unknown species (*Dr. Mercier Gamble*).

Aspidoproctus ? glaber, Lind.

NYASALAND: Mlanje; on "mwanga" tree, x.1913 (*S. A. Neave*).

A small undersized female, unfortunately imperfect. I have placed it here, as it agrees, apart from its size, with Lindinger's description.

Aspidoproctus pertinax, Newst.

NYASALAND: Mlanje; on "kalati" tree, x.1913 (*S. A. Neave*).

Female, young adult: Broadly ovate and highly convex above; covered with a relatively thin layer of very pale yellowish-buff secretion, which is somewhat granular in texture. Margin with a closely set series of large waxen rectangular appendages, a few of which are completely divided longitudinally; dorsum, in the middle line, in front with three pairs of short blunt waxen processes, each surrounded by a fringe-like series of relatively large, granular pieces of wax. Midway between the short dorsal series of processes and the margin is another complete row of tooth-like processes, all of which have a granular fringe. Length 7.5 mm.

The above description was drawn from a specimen which had been preserved in alcohol. Fortunately Mr. Neave collected examples which show the intermediate stages between the quite young adults and the fully matured female, so that there can, I think, be no doubt as to the specific identity of his specimens.

Aspidoproctus ? pertinax, Newst.

SOUTH INDIA: Bangalore, Lal Bagh; on a wild plant, vi.1908 (*T. V. Ramakrishna*, per E. Ballard).

A single and apparently young adult female, which differs externally from typical African examples in having the posterior marginal processes slightly longer and so arranged that they partly overlap. The larvae are inseparable from the cotypes of *A. pertinax* in the author's collection. More material is needed for an exact specific determination of the adult female.

Aspidoproctus ? tricornis, Newst.

NYASALAND: Mlanje; on "mwanga" tree, x.1913 (*S. A. Neave*).

A single immature female which apparently belongs to this species. It differs from the adult in having three relatively small, dorsal, horn-like processes, of which the median one is much the longest and faintly bifid at the tip. Marginal tubercular projections *bifid along the abdominal area*; the flat tooth-like appendages arising from these are, when present, well separated and divergent; some of the appendages on the thoracic margin are broad and flat, with truncated ends; the four cephalic ones bluntly rounded, and with more or less pointed processes.

***Icerya aegyptiacum*, Doug.**

ZANZIBAR: on young date palm, 15.iv.13 (*Dr. W. M. Aders*).

This is the first record of the occurrence of this pest in Zanzibar. The examples were nearly all young females.

***Icerya maxima*, Newst.**

UGANDA: Ngamba Is., Lake Victoria; on tree trunk, 28.vi.14 (*Dr. G. D. H. Carpenter*).

These specimens have a larger number of glands than typical examples; otherwise the structural characters are specifically identical. Unfortunately the external coverings had almost completely macerated in the preservative, so that nothing can be added regarding these.

***Icerya seychellarum*, Westw.**

UGANDA: Entebbe; on mango, 10.iii.14 (*C. C. Gowdey*).

***Icerya sulfurea*, Lind.**

UGANDA: Entebbe; on *Eranthemum*, 4.i.13 (*C. C. Gowdey*).

***Icerya ?sulfurea*, Lind.**

UGANDA: Kampala; on *Castilloa*, 15.viii.13 (*C. C. Gowdey*).

***Stictococcus formicarius*, Newst.**

UGANDA: Entebbe; on *Ficus* sp., 4.xii.12 (*C. C. Gowdey*).

***Stictococcus multispinosus*, Newst.**

GOLD COAST: Aburi; on kola (*W. H. Patterson*); a small percentage of the females were attacked by Chalcidid parasites. UGANDA: Kampala; on *Markhamia platycalyx*, 2.ix.15 (*C. C. Gowdey*); ♀♀, 2-3 ♂ puparia and an imperfect ♂, the last two being new.

***Stictococcus sjöstedti*, Ckll.**

GOLD COAST: Aburi; on cacao (*W. H. Patterson*).

***Pseudococcus citri*, Risso.**

BRITISH EAST AFRICA: Nairobi, Old Government Farm, 5,500 ft., 3.i.13 (*Geo. W. Evans*). UGANDA: Entebbe, on coffee, 13.viii.12; Tero Forest, on an unknown shrub, 13.vii.12 (*C. C. Gowdey*).

***Pseudococcus sacchari*, Ckll.**

MADRAS PRES.: Megapatam; on rice, xi.1914 (*T. V. Ramakrishna* per *E. Ballard*). BRITISH GUIANA: Georgetown; on sugar cane, 27.vii.16 (*G. E. Bodkin*).

The distinguishing features of the adult females are: the presence of a pair of dark brown or piceous plates between the 2nd and 3rd free abdominal segments on the venter; the great length of the transverse coxal sclerite on the anterior legs; and the long bristles on the segment above the anal lobes. The second-stage females are similar, but the anterior coxal sclerites are slightly longer relatively, as compared with the width of the coxae; and there is an additional group of long abdominal hairs above the anal lobes.

Pseudococcus hymenocleae, Ckll.

SOUTH AFRICA: Onderstepoort, Transvaal; food-plant not stated, 1914 (*D. d'Emmerez*).

Pseudococcus virgatus, Ckll.

UGANDA: Nama Konkoni, Chagwe; on coffee (*C. C. Gowdey*). ZANZIBAR: on cassava and sugar-cane, 4.iv.13 (*Dr. W. M. Aders*). GOLD COAST: Aburi, on French beans, *Jatropha curcas* and *Colocasia*, 1.i.13 (*W. H. Patterson*); Accra, on oleander and a creeper called "Salonica," 2.viii.16 (*Dr. J. W. Scott Macfie*). SOUTHERN NIGERIA: Ibadan, on cacao seedlings, 5.xii.11 (*A. D. Peacock*).

Phenacoccus insolitus, Green.

MADRAS: Saidapet; on egg-plant (*Solanum melongena*), 13.vii.07 (*T. V. Ramakrishna*, per *E. Ballard*).

Mr. E. E. Green in his original diagnosis (*Mem. Dept. Agric. Ind.*, ii, p. 26, 1908) states that the 8th and 9th segments of the antennae are "fused together." In several of my examples this character is very pronounced; in others, however, the articulation is as clearly defined as the rest.

Tachardia decorella, Mask.

UGANDA: Entebbe; on *Anona muricata*, heavy infestation, 20.iii.13 (*C. C. Gowdey*). SOUTH AFRICA: Pretoria, 1914 (*D. d'Emmerez*).

Asterolecanium coffeae, Newst.

BRITISH EAST AFRICA: on coffee plants seven miles N.E. of Nairobi, 9.xii.12 (*Geo. W. Evans*). UGANDA: Nakasanja, Chagwe, on coffee, 10.vi.13; Banda, on coffee, 28.vii.16 (*C. C. Gowdey*)—heavy infestations.

Mr. Evans, in a note attached to his specimens, states that this Coccid infests every part of the tree, causing the leaves to droop. He found twenty plants attacked by it. A small percentage of the specimens are infested by Chalcidid parasites. The general colour of the tests of the females is pale yellowish-green. In Mr. Gowdey's specimens the colour of the test of both old and young adults is pale bottle-green, shaded with bright yellowish-green or golden green; the filaments forming the fringe, crest, etc., dull pink. In the adult females the anal lobes are furnished with a single long bristle; these had evidently been broken away in the type material described by me in 1911.*

Asterolecanium bambusae, Bdv.

GOLD COAST: Aburi; on bamboo (*W. H. Patterson*). UGANDA: Entebbe; on bamboo, 7.ii.14 (*C. C. Gowdey*). SOUTH AFRICA: 1914 (*D. d'Emmerez*).

Cerococcus hibisci, Green.

C. hibisci, Green, *Mem. Dept. Agric. India*, ii, no. 2, p. 19, pl. ii (1908).

S. INDIA: Guntur; on egg-plant, 20.iii.10 (*T. V. Ramakrishna*, per *E. Ballard*).

The tests of the females agree best with those forms which are described by Green (*l.c.*) as having a "golden-yellow scurfy tomentum," but the tomentum in my

* *Mitt. Zool. Mus. Berlin*, V. 2, p. 161, fig. 4a.

examples has almost entirely disappeared, owing apparently to detrition, and has assumed a distinct scurfy appearance, which is also patchy and irregular, or arranged in ill-defined transverse bands.

Ceroplastodes cajani, Mask.

S. INDIA: Coimbatore; on red gram; on *Zizyphus*, Feb. 1909; on *Ocimum sanctum*, Feb. 1910; Anantapur Dist., on wild indigo, April 1907 (*T. V. R.*, per E. Ballard).

Inglisia chelonioides, Green.

S. INDIA: Coimbatore; on *Parkinsonia aculeata*, 27.vi.14 (*T. V. Ramakrishna*, per E. Ballard).

Inglisia conchiformis, Newst.

GOLD COAST: Aburi; on *Gliricidia maculata*, 12.i.16 (*W. H. Patterson*). "Native host could not be traced. All available material forwarded. Difficult to dry. No parasites found. No economic damage, as only one plant infested." (*W. H. P.*).

Ceroplastes actiniformis, Green.

S. INDIA: Coimbatore; on coconut, x.1908 (*T. V. R.*, per E. Ballard).

Ceroplastes africanus, Green.

SOUTH AFRICA: 1914 (*D. d'Emmerez*). UGANDA: N.E. of Lake George; on acacia, 20.vi.11 (*C. C. Gowdey*).

The nipple-like process on the dorsum of the waxen test, characteristic of typical examples of this insect, is wanting in all Mr. Gowdey's specimens, the position of these processes being indicated by a rather deep depression.

Ceroplastes ceriferus, Anderson.

S. INDIA: Coimbatore; on "wild elm," x.1909 (*T. V. R.*, per E. Ballard).

Ceroplastes cirripediformis, Comst.

BRITISH GUIANA: Berbice, on *Hura crepitans*, in association with *Lecanium* (*Akermes*) sp., 27.xi.13; Georgetown, on *Ipomea* sp., 3.i.14 (*G. E. Bodkin*).

Ceroplastes denudatus, Ckll.

BRITISH GUIANA: Demerara; on a wild species of Solanaceous plant, x.1915 (*H. W. B. Moore*).

Ceroplastes ficus, Newst.

SOUTH AFRICA: Wonderboom; on *Ochra pulchella*, 1914 (*D. d'Emmerez*). GOLD COAST: Aburi; on *Anona* (*W. H. Patterson*).

Mr. Patterson's ♀♀ are larger than those of the type lot, which came from Uganda (*Bull. Ent. Res.*, i, p. 191, fig. 5).

Ceroplastes personatus, Newst.

GOLD COAST: Aburi; on *Coffea liberica*, 3.xii.15 (*W. H. Patterson*).

This is the only additional record since its discovery in 1898.

Ceroplastes quadrilineatus, Newst.

UGANDA: Kimi Is., Lake Victoria, v.1914 (*Dr. G. D. H. Carpenter*).

Ceroplastes rubens, Mask.

S. INDIA: Ganyon District, Chicacola; on mango, iv.1910 (*T. V. R.*, per *E. Ballard*). ZANZIBAR: Maruhubi; on young orange trees, 16.vii.13 (*Dr. W. M. Aders*). ✓

Ceroplastes ugandae, Newst.

UGANDA: Mount Mubendi; on an unknown tree, 1.x.10 (*C. C. Gowdey*).

It is necessary to call attention to the fact that this insect so closely resembles *Ceroplastes egbarum* subsp. *fulleri*, Ckll., in the form and colour of the waxen test that the two insects are apparently inseparable. But the ♀ of *C. ugandae* may at once be distinguished by the presence of three large bi-lateral tubercles, all of which are distinctly larger than the rudimentary caudal process. "The broadly ovate group of circular pores," described by me* as occurring immediately above the stigmatic clefts, are really not pores but minute conical spines. In a well cleared specimen which is now before me, these structures are very distinctly displayed.

Ceroplastes vinsonioides, Newst.

UGANDA: Mabira Forest; on coffee, 28.xii.12 (*C. C. Gowdey*).

Pulvinaria burkilli, Green.

S. INDIA: Coimbatore; on *Zizyphus* sp., 19.iii.13 (*T. B. Fletcher*).

Two imperfect females and many male puparia. One example has the normal number of segments to the antennae (eight), while the other presents only seven, of which the 4th is nearly as long as the 3rd.

Pulvinaria cupaniae, Ckll.

JAMAICA; on *Ficus* sp., 1916, heavy infestation; "on mulberry imported last year from U.S.A.," v.1916 (*A. H. Ritchie*). ✓

Pulvinaria jacksoni, Newst.

UGANDA: Kampala; on *Aranthemum bicolor*, 4.viii.15 (*C. C. Gowdey*); chiefly young adult ♀♀ without ovisacs. BRITISH EAST AFRICA: Nairobi; on granadilla, iii.1914 (*T. J. Anderson*). ✓

Pulvinaria psidii, Mask.

UGANDA: Mabira, on coffee, 15.x.10—heavy infestation; Mpumu, Chagwe, on coffee, 12.xii.12 (*C. C. Gowdey*). BRITISH EAST AFRICA: Kikuyu, on coffee, i.1914 (*T. J. Anderson*); Bukoba, on "nsambyia," 8.vi.12 (*C. C. Gowdey*). S. INDIA: Coimbatore, on mango, Feb. 1914; Koilpati, on guava, x.1907 (*T. V. R.*, per *E. Ballard*). ✓

Ten of the Mabira females were prepared for microscopical examination; all of these had their bodies completely traversed by the hyphae of a fungus, which I believe to be a primary parasite.

* Bull. Ent. Res., ii, p. 94, fig. 8c (1911).

The derm cells in these examples from East Africa appear somewhat larger and less oval than I have seen in other specimens from Africa ; possibly due to the age of the individuals.

Lecanium (Saissetia) cuneiformis, Leon.

BRITISH EAST AFRICA : Mua Hills ; on *Acocanthera* sp., i.1914 (*T. J. Anderson*).

Lecanium (Saissetia) hemisphaericum, Targ.

BRITISH EAST AFRICA : Limosa, ii.1914 (*T. J. Anderson*). UGANDA : Nagunga, on *Aristolochia*, 20.ix.15 ; Entebbe, on *Adiantum*, 10.ii.14—curiously stunted forms, such as are not infrequent on the stems of *Adiantum* ; Mabira, on coffee, 29.vii.13 (*C. C. Gowdey*).

Lecanium (Coccus) hesperidum, Linn.

BRITISH EAST AFRICA : near Mombasa, on banana, i.1914 ; Mua Hills, on lemon, i.1914 (*T. J. Anderson*).

Lecanium (Saissetia) nigrum, Nietn.

S. INDIA : Coimbatore ; on *Lawsonia alba*, iv.1910, and on cotton, very heavy infestation, viii.1910 (*T. V. R.*, per *E. Ballard*). UGANDA : M̄wera ; on coffee, 29.vii.13 (*C. C. Gowdey*). BRITISH EAST AFRICA : Government Farm, Kabete ; on ornamental shrub, i.1914 (*T. J. Anderson*).

Lecanium (Eulecanium) somereni, Newst.

UGANDA : Nagunga ; on *Erythrina excelsa*, 20.ix.15 (*C. C. Gowdey*).

The specimens are of an unusually dark colour and heavily parasitised.

Lecanium (Eucalymnatus) tessellatum, Sign.

BRITISH GUIANA : Botanic Gardens, Georgetown ; on Malacca apple, 28.vii.15 (*R. Ward*, per *G. E. Bodkin*) ; associated with *Lecanium wardi*, sp. n.

These examples show a considerable variation in the arrangement of the plates which form the tessellated pattern of the dorsum. Some agree with Signoret's description (the first I have seen) ; others (two) with the var. *perforatum*, Newst., though these are not quite typical.

Lecanium (Coccus) viride, Green.

BRITISH GUIANA : Onderneeming, Essequibo, 60 ; on Liberian coffee, 29.vii.13 (*G. E. Bodkin*). SOUTH AFRICA : 1914 (*D. d'Emmerez*) ; all immature ♀♀, differing from typical examples of *L. viride* only in that some have eight instead of seven segments to the antennae.

Hemilecanium imbricans, Green.

S. INDIA : Southern Mysore ; on *Cedrela tuna*, heavy infestation, xi.1903 (*E. Ballard*).

Aspidiotus (Chrysomphalus) aurantii, Mask.

BRITISH EAST AFRICA : Kabete ; on orange tree, 7.i.14 (*T. J. Anderson*). SOUTHERN RHODESIA : Mt. Chirinda, Melsetter (*C. F. M. Synnerton*)—very heavily

infested by a fungus, apparently a species of *Nectria*; Chalcidid parasites also present. SOUTH AFRICA: Pretoria; on *Acacia*, 1914 (*D. d'Emmerez*)—a few examples living in association with *Chionaspis capensis*, Newst. JAMAICA: on citrus imported from India in 1913, 15.iii.16 (*A. H. Ritchie*). FIJI: Taveuria; on bananas, 1913 (*Chas. H. Knowles*).

***Aspidiotus camelliae*, Sign.**

BRITISH EAST AFRICA: Nairobi, 5,500 ft., on apple, 3.i.13, and on rose-tree, 6.vi.12 (*Geo. W. Evans*); Kabete, on trunks of black wattle, 7.i.14, and on apple and fig, iii.1914 (*T. J. Anderson*).

***Aspidiotus cyanophylli*, Sign.**

UGANDA: Entebbe; on peach, 4.xii.12 (*C. C. Gowdey*). FIJI: Taveuria; on bananas, 1913 (*Chas. H. Knowles*).

***Aspidiotus cydoniae*, Comst.**

BRITISH EAST AFRICA: Kabete, on mango, 7.i.14 (*T. J. Anderson*). UGANDA: Entebbe, on *Bauhinia*, 4.ii.14, on guava, 10.ii.14, and on rose shrubs, 24.v.12; Kampala, on "Cape lilac," 4.viii.15 (*C. C. Gowdey*). GOLD COAST: Accra, on oleander, 12.iv.16 (*Dr. J. W. Scott Macfie*). JAMAICA; on *Nectandra coriacea*, 1916 (*A. H. Ritchie*). S. INDIA: Coimbatore, on fig fruit, v.1912, and on vine, xii.1909; Bangalore, on pear, iii.1910 (*T. V. Ramakrishna*, per E. Ballard).

***Aspidiotus destructor*, Mask.**

S. INDIA: Cochin State, Kimbalengua; on cocoanut leaves, 8.viii.08 (*E. Ballard*)—heavy infestation, but about 70 per cent. destroyed by a small Coleopterous larva. ZANZIBAR: Marahubi; on mango, 24.iv.13, in association with *Lecanium adersi*, Newst.; on stems of castor oil plant, 16.vii.13 (*Dr. W. M. Aders*)—the examples on the last-named plant have very remarkable puparia, being highly convex and exceedingly thick and robust. SOUTH AFRICA: on an unnamed plant, 1914 (*D. d'Emmerez*). BRITISH EAST AFRICA: Mombasa, on cocoanut palm, 7.i.14 (*T. J. Anderson*). UGANDA: Kisube, on banana, 10.viii.13; Entebbe, on mango, 13.i.13, on guava, 10.iii.14, on screw-pine, 16.iii.14, and on Ceara rubber, 10.vii.13; Kampala, on banana, 8.x.13, and on *Hevea brasiliensis*, 26.x.13 (*C. C. Gowdey*). GOLD COAST: Accra, on mango, 6.xi.16 (*Dr. J. W. Scott Macfie*); Aburi, on *Pandanus* (*W. H. Patterson*).

***Aspidiotus (Chrysomphalus) dictyospermi*, Morgan.**

S. AFRICA: Fort Beaufort, 1914 (*D. d'Emmerez*).

***Aspidiotus (Chrysomphalus) ficus* (Riley), Comst.**

S. INDIA: Coimbatore, on mango, 11.1914; Pemkonda, on *Ficus* sp., iii.1907 (*T. V. R.*, per E. Ballard).

***Aspidiotus (pseudaonidia) fossor*, Newst.**

BRITISH GUIANA: Georgetown, on grape-vine, 10.viii.13 (*G. E. Bodkin*).

Aspidiotus orientalis, Newst.

BRITISH EAST AFRICA: no data (*T. J. Anderson*). S. INDIA: Coimbatore, on tamarind fruit, ii.1911 (*T. V. R.*, per *E. Ballard*), very heavy infestation; Guntur, on egg-fruit, 20.iii.10 (*T. V. R.*, per *E. Ballard*), heavy infestation.

A large proportion of the African adult females have the margin of the cephalo-thoracic area chitinated, a character not noted in the type lot, but present also in examples from Southern India.

The incorporation of the epidermal layer of the fruit in the Coimbatore puparia has given them a distinctly russet-red colour. The three large bilateral squamae in nearly all of the examples examined are almost entirely free from the minute lateral serrations which may be clearly seen in typical examples; otherwise the structural characters are specifically identical. The puparia of the Guntur females are much more robust than those of the co-types, and bear a striking resemblance to those of *A. cydoniae*, Comst.

Aspidiotus (Chrysomphalus) rossi, Mask.

S. AFRICA: Modderfontein; on *Eucalyptus* sp., 1913 (*D. d'Emmerez*).

Aspidiotus (Pseudaonidia) tesseratus, d'Emm.

JAMAICA: on *Matyba apetala*, *Nectandra coriacea*, Gr., *Trophis racemosa*, Urt., 1916 (*A. H. Ritchie*); all heavy infestations.

Aspidiotus (Pseudaonidia) trilobitiformis, Green.

S. INDIA: Coimbatore, viii.1912 (*T. B. Fletcher*). UGANDA: Kampala, on oleander, 20.vii.15, on mango, 20.vii.15 (*C. C. Gowdey*).

Aspidiotus (Chrysomphalus) triglandulosus, Green.

S. INDIA: Bangalore: "attached to scabs on Jack leaf," vi.1912 (*T. B. Fletcher*).

Aspidiotus (Selanaspidus) silvaticus, Lind.

UGANDA: Entebbe, on *Citrus aurantium*, 7.ix.13 (*C. C. Gowdey*).

Female puparium: More or less circular or somewhat deltoid when arrested by the prominent veins of the leaf; thin and flat. Exuviae central in the circular forms, and submarginal in the deltoid ones. Those on the upper surface of the leaves russet-buff, with broad pale margins and slightly darker exuviae; on the underside more opaque and brownish buff, with obscure buff-yellow exuviae. Greatest diameter 2-2.6 mm. *Female adult*: Very broadly pyriform; thoracic constriction slightly less than one-third the entire length of the body; thoracic tubercle apparently absent. Pygidium roughly triangular in outline; its margin with two pairs of well developed lobes, the median pair deeply emarginate on both sides; the curiously forked squamae beyond the usual prominent tooth-like process seem to be characteristic of the species.

Lindinger's* examples of the puparia were evidently very much smaller, but the structural details given by him (*l.c.*) of the adult female agree in all essentials. Quite 50 per cent. of the females were attacked by a parasitic fungus.

* *Jahr. der Hamb. Wissen. Anst.*, xxvi, p. 10, taf. iii (1909).

Aspidiotus (Selanaspidus) articulatus, Morg.

JAMAICA: Kingston; "on citrus imported from India," 15.iii.16 (*A. H. Ritchie*).

Chionaspis (Hemichionaspis) minor, Mask.

SOUTHERN NIGERIA: Ibadan; food-plant not stated (? cotton) (*Dr. W. A. Lamborn*). GOLD COAST: Aburi, on *Jatropha curcas* (*W. H. Patterson*); the female puparia are larger and much more dilated than typical examples; otherwise they do not materially differ. SOUTH AFRICA: Drakensburg, Cape Province; on willow trees (*D. d'Emmerez*).

Cooley* has described a variety of this species, under the name *strachani*, from material collected on an unknown plant from Abeokuta, West Africa, and states that it differs from *H. minor* "in having the exuviae of the female scale rather darker and contrasting more strongly with the secreted portion, and in having the median lobes broader in proportion to their length and more finely and less distinctly crenate." *Dr. Lamborn's* examples of the females do not exhibit any morphological characters by means of which one can separate them from typical *H. minor*; but the puparia of the females show a somewhat marked departure from *Maskell's*† description in having the secretory portion much more widely pyriform, dusky white, and relatively thin and smooth.

Chionaspis dentilobis, Newst.

UGANDA: Entebbe, on an unnamed plant, 6.v.10 (*C. C. Gowdey*).

A large percentage of the females were parasitised, evidently by Chalcidid Hymenoptera.

Chionaspis (Phenacaspis) lutea, Newst.

GOLD COAST: Aburi, on *Funtumia* (*W. H. Patterson*).

The male puparia associated with the females in this colony are very strongly tricarinate and not at all like those in the type lot described from East Africa.‡ Possibly the West African examples belong to a species of *Diaspis*. The ♀♀ are specifically identical with the co-types of *C. lutea*.

Fiorinia proboscidea, Green.

JAMAICA: Kingston, "on citrus imported from India," 15.iii.16 (*A. H. Ritchie*).

This species has not hitherto been reported from the West Indies.

Parlatoria pergandei, Comst.

JAMAICA: Kingston, "on citrus imported from India, 1913," 15.iii.16 (*A. H. Ritchie*).

Parlatoria ziziphus, Lucas.

JAMAICA: Kingston, "on citrus imported from India, 1913," 15.iii.16 (*A. H. Ritchie*).

* *Special Bull. Hatch Exp. Stn., Mass. Agric. Coll.*, 10th Aug. 1899, p. 54.

† *N.Z. Trans.*, xvii, p. 33, pl. vi, fig. 4 (1884).

‡ *Mit. Zool. Mus. Berlin.*, v, 2, p. 169 (1911).

Ischnaspis filiformis, Doug.

JAMAICA : on *Ficus* sp., 1916 (*A. H. Ritchie*). UGANDA : Mabira Forest, Chagwe ; on coffee, 28.xii.12 (*C. C. Gowdey*).

Mytilaspis (Lepidosaphes) citricola, Pack.

GOLD COAST : Accra, on a sickly lime-tree, 12.ii.16 (*Dr. J. W. Scott Macfie*).

Lepidosaphes gloverii, Pack.

UGANDA : Entebbe ; on croton, 10.vii.13 (*C. C. Gowdey*).

THE EARLY STAGES OF CERTAIN WEST AFRICAN MOSQUITOS.

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(PLATES I—IV.)

Howard, Dyar and Knab in their monograph "The Mosquitoes of North and Central America and the West Indies," in discussing the rearing of mosquitos, emphasise the importance of larvae in specific determination. They write (Vol. I, p. 181) "Many species of *Culex* are of uncertain determination without the associated larvae, while some *Aedes* have identical adults, yet dissimilar larvae. The characters of the larvae reside in the modifications of the chitinous appendages of the skin and the arrangement of the hairs. As these are fully retained by the cast skins, it is possible to preserve both the larva and the adult of the same identical specimen, thus assuring absolutely correct associations." This plan has been carried out so far as possible in the rearing of the mosquitos, the larvae of which—obtained during 1916 in Accra and its vicinity—we have attempted to describe below.

We take this opportunity of pointing out that so far as our experience of the mosquitos of Accra goes, Howard, Dyar and Knab are in error in controverting the statement of the late Sir Rubert Boyce that mosquitos living in crab-holes "are the chief nuisance in those houses which are situated near the sea." Howard, Dyar and Knab write: "Our observations prove that the crab-hole mosquitoes do not bite nor annoy man and no consideration need therefore be given to their destruction." In Accra *Culex thalassius*, *Ochlerotatus irritans* and *Anopheles costalis* are commonly found flourishing in crab-holes, all of these mosquitos are vicious biters and invade houses; their destruction therefore is one of the problems which must be faced by Sanitary Authorities on the West Coast of Africa, especially as *A. costalis* is a proved carrier of malaria.

We have here to express our indebtedness to Dr. A. C. Parsons, Junior Sanitary Officer at Accra, and to Dr. J. B. Alexander, Medical Officer of Health at Accra, for their untiring zeal in procuring for us specimens of larvae. Our thanks are again due to Dr. G. A. K. Marshall, of the Imperial Bureau of Entomology, and to Mr. F. W. Edwards, of the British Museum, for much help and advice and for identifying species.

Anopheles marshalli, Theo.

The head is small as compared with the thorax. The brushes are prominent. The antenna possesses no hair-tuft and its surface is covered with minute spines, which, however, are almost absent externally. At the end of the antenna there are stout spines and a short branched hair; this hair shows at least three branches. The anterior frontal hairs (clypeal hairs) are all simple and appear to be placed in a triangle, one being situated anteriorly and two posteriorly; of the two posteriorly placed hairs the external is only slightly in advance of the internal. The internal posterior hair is nearly twice as long as the others. The mental plate is small and carries a median tooth with four teeth on either side.

The thoracic plumes are fairly developed, the median hairs overlap the occiput. There are no rudimentary palmate hairs on the thorax or the first two abdominal segments.

There are long lateral feathered hairs on the first three abdominal segments and all the segments bear short branched hairs laterally. Palmate hairs are present on the fourth to the seventh abdominal segments. The leaflets of which these hairs are composed show no shoulder and scarcely any filament. Upon an average there are nine hairs on each side of the main stem (in *A. costalis* the average number is seven) when the structure is looked at in profile. The comb differs from the comb of *A. costalis* in that the long teeth are, relatively to the short teeth, more elongate and more numerous. Wesché, describing the comb of *A. costalis* (Bull. Ent. Res., i, p. 21) in the various stages of development of the larva, says of the final stage, "the character of the comb remains the same, four short spines followed by a long one." In the comb of *A. marshalli* there appear to be three short spines followed by a long one.

This larva falls into the same group as *A. pretoriensis* and *A. rufipes* in Edwards' key (Bull. Ent. Res., iii, p. 374), but is distinguished from them by having no palmate hairs on the second abdominal segment.

Breeding place.—This larva was taken in a *Pistia*-covered pool at Christiansborg, near Accra (see Pl. II, fig. 1). From the same pool larvae of *A. costalis*, *Aedfomyia* 27 *africana*, *Culex quasigeliidus*, *Mimomyia splendens* and *Mansonioides africanus* were obtained.

***Stegomyia simpsoni*, Theo.**

The head is small and moderately chitinated. The antenna is short and bears in place of the tuft a single hair at about its middle or a little beyond. There are several small tufts of hairs and one tuft of three long hairs arising between the base of the antenna and the eye and projecting laterally. The mental plate has a median pointed tooth of moderate size and ten or eleven smaller teeth on each side, the two outermost teeth being much smaller than the others. The brushes are small.

The thoracic plumes are not very strongly developed and are composed of simple hairs. The hook-like spines at the bases of the ventral plumes are about as strongly developed as those of *S. fasciata*.

The abdomen is not conspicuously hairy and is without true stellate hairs. All the hairs are simple. The hairs forming the siphonal, subsiphonal, and anal plumes appear also to be simple. The comb consists of a row of seven or eight spines barbed at their bases, which resemble those of *S. fasciata* but are rather less strongly barbed. The siphon is less than twice as long as its basal diameter. The pecten is composed of about eight slightly barbed spines. The tuft is situated just beyond the middle of the siphon and is composed of three simple hairs; it lies at about the same level as the last pecten spine. The beard is poorly developed. The dorsal hairs on the anal segment are three above and one below on each side. The anal papillae are long and blunt at the ends.

The above description was made from a single specimen, but unless it was an abnormal one, this larva can be distinguished from the other known larvae of this genus with barbed comb spines and without conspicuously hairy abdomens by its pecten of only eight spines.

Breeding place. The larvae of this species were found in rot-holes in trees and were associated with larvae of *Culicomyia nebulosa*, *Stegomyia fasciata*, *S. metallica*, *S. unilineata*, and *S. luteocephala*.

***Stegomyia unilineata*, Theo.**

The head is small, though well chitinated. The antenna is short, and there is no hair-tuft, a single or bifid hair being, however, visible at about half the length of the shaft. In one of the specimens examined a distinct constriction occurred in the antennae at a fourth of the length from their bases. Several tufts of stout hairs may be seen on the head. The mental plate carries a substantial median tooth with ten more slender teeth on each side, the lateral teeth becoming broader and more widely separated towards the base of the plate. The brushes are small.

The thoracic plumes are short and are formed of hairs which are subplumose at their bases. The hook-like spines visible at the bases of the ventral plumes on the thorax of some other members of this genus are scarcely perceptible.

Numerous hair-tufts are present on all the abdominal segments, these are not true stellate hairs, but resemble the hair-tufts on the abdominal segments of *S. luteocephala*. A few of the constituent hairs are pubescent, the majority are simple. The hairs forming the subsiphonal, siphonal and anal plumes show slight pubescence. The comb consists of about eight spines with fringed bases set in a single row. The siphon is about twice as long as the diameter of its base, and there are 8-12 barbed spines in its pecten; distal to the pecten is a tuft of four or five simple hairs, situated a little beyond the middle of the siphon. The anal segment carries a scanty beard; the hairs on the end of the dorsum are three above and one below on each side, and there is a tuft of five stout hairs which are simple — on the lateral aspect of the segment. The papillae are long and blunt-ended.

This larva may be distinguished from other larvae of the same genus which have numerous hair-tufts on the abdominal segments by the absence of hook-like spines on the thorax.

Breeding place. The larvae were found in association with the larvae of *S. luteocephala*, *S. metallica* and *S. simpsoni* in a rot-hole holding a small quantity of water in the trunk of a Flamboyant tree (*Poinciana regia*) in the laboratory compound at Accra (Plate IV, fig. 2).

***Mansonioides africanus*, Theo. (Plate I, figs. 1, 3; text-fig. 1).**

The larva of *Mansonioides africanus* has already been described by Ingram (Bull. Ent. Res. iii, p. 76), and has also been figured by Edwards (Bull. Ent. Res. iii, p. 377). The siphon tube is complex and would appear to resemble that of *Mansonia titillans*, a South American mosquito, the larva of which also attaches itself to the roots of *Pistia*. A general description of this tube has already been published, but a more detailed account of the structure, especially that of the apical third, may be of interest as indicating the high degree of specialisation of the breathing apparatus of the larva of this species.

The apical third of the siphon tube is more highly chitinated than the basal two-thirds and appears to be movable on the latter portion. It is an incomplete tube composed of two lateral chitinous lamellae with a ventral membrane connecting (C394)

them, but dorsally it is open to accommodate the saw-like element to be referred to immediately. The lateral chitinous lamellae extend to the tip of the siphon, where they come into relationship with the ends of the internal structures, and they bear at their extremities two pairs of slightly chitinated hooks. At the base of each lamella there is a single bristle, which lies therefore at about the same level as the

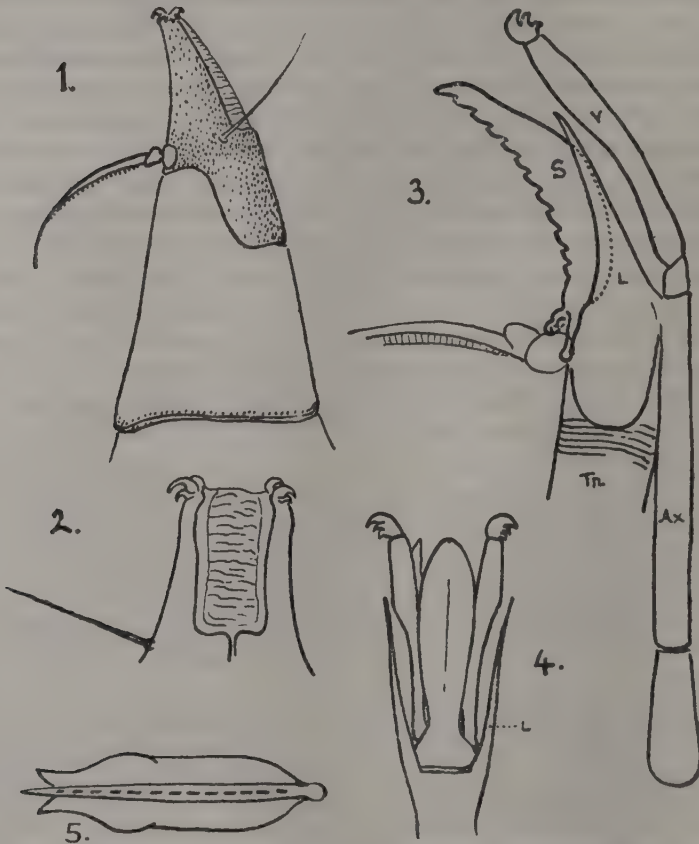


Fig. 1. Siphon of *Mansonioides africanus*; (1) outer case, lateral view; (2) apical third of the outer case, ventral view; (3) inner elements: Tr, trachea, S, saw, L, the lateral pieces, V, ventral pieces, Ax, axial rod; (4) ventral pieces flattened out and seen from the ventral aspect: L, the lateral pieces in profile; (5) saw flattened out, dorsal view.

larger dorsal bristles, but more ventrally and not as figured by Edwards. These bristles are simple and are not furnished with a fringe or membrane. The ventral membrane is feebly chitinated and is irregularly ribbed or folded transversely, so that in profile it looks like the edge of a file. It is attached laterally and basally to the chitinous part of the siphon by a delicate membrane.

Within the siphon tube a number of complicated structures can be seen. Running from end to end of the tube and extending for some distance into the abdomen there is an axial rod of chitin, a narrow flat structure with its edges directed towards the dorsal and ventral aspects of the siphon, and with a hinge or joint at its lower end. The two tracheal trunks pass upwards inside the siphon to the right and left of this axial rod; in the apical third they lose their spiral structure and unite with the rod so as to form the "common hollow space" described by Raschke. This arrangement is usual in mosquito larvae, but in the case of *Mansonioides africanus* the margins of the space do not form simple valves, but are highly specialised so as to enable the larva to penetrate the roots of *Pistia stratiotes* and to attach itself firmly to the plant. Laterally the outer walls of the tracheal tubes are continued as highly chitinated plates, which rapidly taper to points. On the ventral aspect the axial rod is continued as a stout, highly chitinated structure, on which a trough-shaped body composed of a mesial and two lateral parts is jointed, each of the lateral pieces bearing at its distal end a triple hook of great strength. A delicate flexible membrane connects the bases of these hooks with the edge of the siphon. On the ventral margin of the "common hollow space" a highly chitinated trough-shaped structure with a saw-like dorsal keel is hinged. Howard, Dyar and Knab state that in *Mansonia* the "outer portion of the tube is . . . furnished with serrations," but in *Mansonioides africanus* the saw appears to be attached to the margin of the "common hollow space" and to be separate from the tube, and for these reasons we conclude that it probably represents a modified valve. These structures may perhaps be correlated with the primitive elements in the closing mechanism above the spiracles of Anopheline larvae, corresponding respectively to the lateral flaps, the posterior plate, and the anterior fan-shaped plate.

The saw-like structure has about fourteen teeth and appears to be attached a little above its lower end to the dorsal margin of the "common hollow space." Its lower end divides, a strong median process passing down into the siphon tube and two knob-like bodies projecting dorsally so as to lie between but in close apposition to the bases of the two stout curved bristles situated at the junction of the apical third of the siphon with the basal portion. These bristles have a delicate fringe or membrane on their lower surfaces, which suggests that they may have a sensory function and may be of service to the larva when feeling its way between the rootlets in search of a suitable point at which to attach itself. The larvae of *Mansonioides africanus* after the first instar attach themselves to the tap-roots of *Pistia* plants; they swim about in the water until they encounter the rootlets and then, tail foremost, follow these inwards to the root itself. In this manoeuvre vision can be of little assistance to them; but if the large bristles are sensory, as we suggest they may be, they might help the larvae to reach the root, and, once arrived, might transmit a stimulus enjoining the larvae to attach themselves.

The actual process by which the larvae penetrate the tissues of the root, appreciate the fact when they have reached the air-containing tubes, and fix themselves firmly, must be a matter of surmise, but as extremely powerful muscles are attached to the axial rod, it may be conjectured that this structure plays an important part both by approximating the terminal elements, so as to form a sharply pointed cone for thrusting into the root, and by putting into action the saw-like structure attached to it, which,

as we have stated, is poised on the dorsal margin of the "common hollow space" as its fulcrum. The six sets of terminal hooks no doubt suffice to anchor the larvae once they have penetrated the plant tissues. In specimens killed and fixed *in situ* and subsequently cleared, the siphon is seen to be embedded in the root up to a point about half-way between the tip of the tube and the bases of the dorsal bristles, the hooklets at the end are spread out in a cluster and appear to be firmly fixed in the tissues, and the dorsal and ventral bristles of the siphon are widely extended with their tips in contact with the surface of the root.

The siphon of the larva in the first instar bears but a slight resemblance to that of the fully-developed larva, it is a bottle-shaped structure, which is made up of a conical basal portion (8.5 units) and a more highly chitinated and slender apical portion (7.5 units). The basal ring is hardly visible, the movable junction between the apical third and the basal portion is indistinguishable, but the chitinated axial rod is well developed and has powerful muscles attached to it in the lower half of the tube. About half-way up the lower part of the siphon and slightly on the ventral aspect, that is, in the position occupied by the tuft in the fully-developed larva, there is a single, very long, simple hair. At the shoulder of the bottle, that is, at the point where the narrow part of the siphon commences, the tracheal trunks are constricted, and from this level run up the distal end of the siphon as two chitinated tubes separated by the axial rod. At the tip of the siphon on the ventral aspect there is a pair of powerful highly chitinated double hooks, corresponding with the similar triple hooks of the fully developed larva; dorsally there are two pairs of less highly chitinated hooks, which are toothed; and a pair of relatively stout bristles mounted on large bases can be distinguished, which appear to represent the dorsal bristles of the later stages. The saw-like structure on the dorsal aspect is not developed at this stage. The relatively poor development of the terminal structures is no doubt associated with the habit of the larva in this instar of attaching itself to the rootlets instead of to the tougher tap-root.

The larva at this stage, the first instar, differs in many other respects from the fourth phase larva. The head is large, considerably larger than the thorax; the antennae are relatively huge, possessing the two prominent bristles which are conspicuous in the fully-grown larva, and have in place of the tuft a single stout branched hair. The mental plate is small and has three slender lateral teeth on each side of the prominent mesial tooth. The eyes are prominent and rounded; the "main" eye is not yet developed. The lateral abdominal hairs are two on the first, and one on each succeeding segment. The comb consists of three to five fringed spines, quite unlike the curious elements of the comb of the fully-developed larva. The tuft on the siphon is represented by a simple stout hair, and all the plumes of the eighth segment are in this stage simple hairs. The dorsal hairs on the anal segment are conspicuous, arranged in pairs, the ventral pair being shorter than the dorsal: there is no beard. The anal papillae are equal, and have rather less sharply pointed ends than those of the fully grown larva.

After the first moult the siphon assumes the form described as being characteristic of the species. The dorsal saw-like structure is well developed in the second instar, but has rather fewer teeth than in the fully developed larva.

The egg.—The eggs are laid on the under surfaces of the leaves of *Pistia stratiotes* in clusters or cushions about 2–3 mm. in diameter, containing about 150 eggs apiece. Each egg is rounded at its attached end, but prolonged into a snout at its free end, is dark brown in colour with the surface covered by a cellular reticulation, and measures about 0.96 mm. in length and 0.17 mm. in breadth at its widest part. At the blunt end of the egg there is a layer of clear, colourless material to attach it to the surface of the leaf. The pointed end projects freely and bears at its extremity the micropilar apparatus consisting of a cap-like mass of clear, colourless material similar to that at the rounded end. This cap is readily detached, revealing the presence of four blunt processes at the end of the egg.

The egg-masses lie on the under surfaces of the outer leaves. As the plant unfolds, the leaves become nearly horizontal, and in this position the cushions of eggs come into contact with the water, the pointed ends of the eggs being directed downwards. When the larva hatches the egg breaks horizontally at its widest point, detaching a cone-shaped piece about 0.37 mm. long consisting of the end of the egg and the micropilar apparatus. This cone falls to the bottom of the water. The larva on escaping also descends to the bottom and attaches itself to the root of a *Pistia* plant, selecting a delicate rootlet and not the main tap-root as the older larvae do.

Breeding place.—The larvae of *Mansonioides africanus* are found in pools and swamps in which *Pistia stratiotes* is growing (see Plate I, fig. 1; II, fig. 1), but up to the present we have not found them associated with any other water-plants. At Accra we obtained specimens regularly from a particular pool from April to November. In April and at the beginning of May the larvae were difficult to find, in June they were very numerous, in July and August they diminished in numbers, and in September and October they were again very few. They were most plentiful therefore during the rainy season, which at Accra reaches its height in June.

***Ochlerotatus albocephalus*, Theo. (fig. 2).**

The larva has a small and dark head, slightly more than half as wide as the thorax; the antennae are slender, curved and covered with spicules, the tuft is placed about the middle and consists of a few subplumose hairs. The midfrontal hairs are multiple (5–8) and are plumose; the brushes are prominent, being composed of coarse hairs. The eyes are large. The mental plate has a large median tooth and nine smaller teeth on each side of it.

The thoracic plumes are poorly developed, the constituent hairs being plumose. The lateral abdominal hairs are multiple on the first segment, triple on the second, and single on the remaining segments. The comb consists of 12–15 barbed spines placed in an irregular row. The subsiphonal plume is composed of subplumose hairs, the siphonal plume and the anal plume consisting of pubescent hairs, and there is a single independent hair adjacent to the anal plume. The siphon is about three times the diameter of its base; the pecten comprises 9–11 spines, which become slightly larger and are more widely separated distally; a tuft of simple hairs is situated just beyond the middle of the siphon (35–60). The anal segment is broader than it is long (22 × 19); the anal papillae are almost equal in length, stout and with sharply pointed ends, being longer than the anal segment (28 : 19). The beard is well

developed, extending all the length of the ventral surface of the segment. The hairs on the dorsal end of the anal segment are quadruple above and single below on each side.

This larva may be distinguished from the other known African *Ochlerotatus* larvae (Edwards' key, Bull. Ent. Res., iii, p. 376, and Bull. Ent. Res., vii, pp. 5-6) by its possessing multiple mid-frontal hairs with a pecten of only 9-11 spines.

Breeding place.—The larvae were found in a variety of situations, namely, in small cavities washed out by the sides of cement drains running across an open and wind-swept golf-course, in an empty grave in the Accra cemetery, in broken pipes, earth drains, pools and crab-holes. Associated with them, *A. costalis* and *C. thalassius* were frequently found, and once *C. fatigans*.

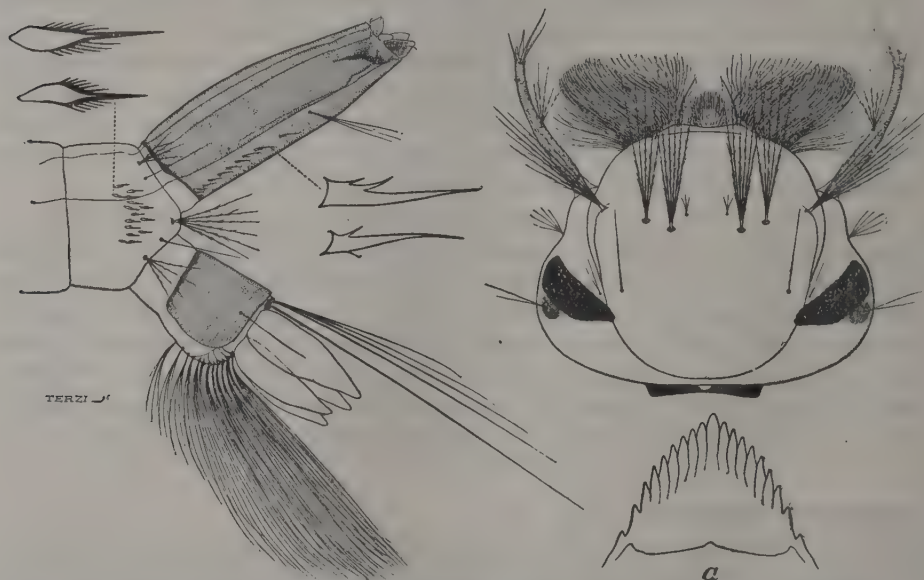


Fig. 2. Larva of *Ochlerotatus albocephalus*, Theo.; head and end of abdomen; a, mental plate.

The larval stage appeared to be passed through very rapidly, as some of the samples in which pupae predominated were taken from pools that could not have been in existence more than three or four days. The attitude of the larvae when at the surface of the water was characteristic, the body and the siphon tube being almost in line or forming an exceptionally obtuse angle.

***Ochlerotatus minutus*, Theo. (fig. 3).**

The head is small, narrower than the thorax (52 : 80), and not so highly chitinised as the head of *O. albocephalus*. The antenna is curved, slender and covered with spicules; it carries a tuft of subplumose hairs at its middle. The mid-frontal hairs are peculiar in that they are delicately branched; they are multiple, numbering 6-8. The ante-antennal tuft is composed of 9-10 plumose hairs. The mental plate has a small median tooth and 9 lateral teeth on each side.

The thoracic plumes are formed of plumose hairs and are poorly developed. The lateral abdominal hairs are multiple on the first segment, triple on the second segment, and single on the remaining segments. The comb consists of 12-15 barbed spines set in a triangular patch. All the hairs forming the siphonal, subsiphonal and anal plumes appear to be subplumose. The siphon is slightly swollen about its middle and is rather more than three times as long as the diameter of its base, its pecten shows nine spines, which increase in length and are more widely separated distally; there is a slender tuft of simple hairs just beyond the middle (34/58). The anal segment is longer than it is broad (23 : 19); the beard does not appear to

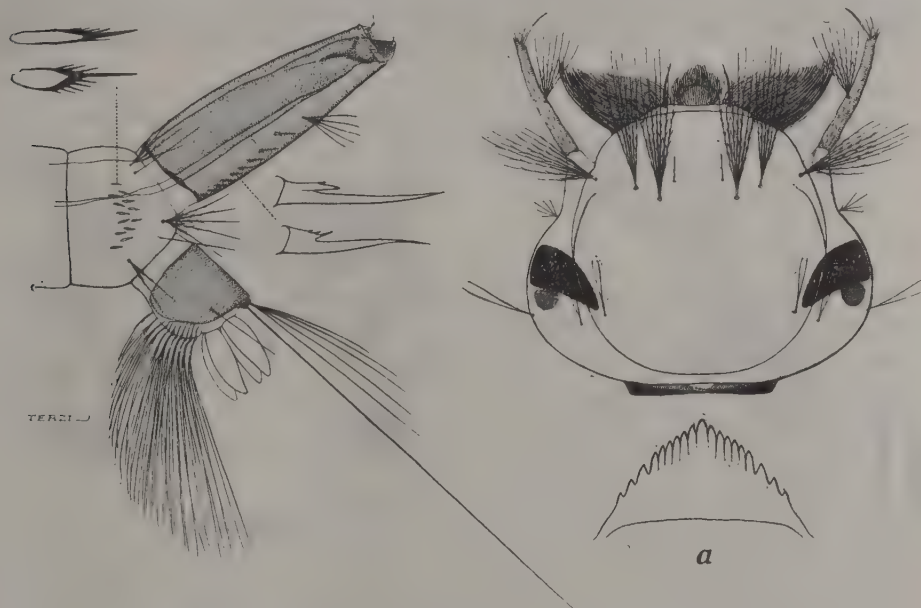


Fig. 3. Larva of *Ochlerotatus minutus*, Theo.; head and end of abdomen;
a, mental plate.

extend the full length of the ventral surface; the hairs on the dorsal end of the segment are a tuft of 5-6 hairs above and of one stout hair below on each side. The anal papillae are short and bluntly pointed.

This larva may be distinguished from other known African *Ochlerotatus* larvae (Edwards' key, Bull. Ent. Res., iii, p. 376, and Bull. Ent. Res., vii, pp. 5-7) by the fact that its multiple frontal hairs are delicately branched.

Breeding place.—The larvae were found in April at the margin of a lagoon in crab-holes that had been enlarged by children digging for crabs (Plate II, fig. 2). The water in which they were living was dirty, thick with deposit, and quite salt. In the same holes larvae and imagines of *Culex thalassius* were also found.

The occupants of the house neighbouring the lagoon were much troubled by mosquitos, and a small collection made on the same day as that on which the larvae were found contained specimens of both *O. minutus* and *C. thalassius*.

***Ochlerotatus apicoannulatus*, Edw. (fig. 4.)**

The whole larva is of a dark brown colour and very opaque, so that it is difficult in an uncleared specimen to distinguish details.

The head is a little more than half the width of the thorax, being well chitinised. The antenna is of a light brown colour, curved, and covered with spicules. The whole antenna measures about 25 units and carries a tuft of five or six subplumose hairs at 11 units from its base. The mid-frontal hairs are multiple (8-10) and are plumose; the ante-antennal tuft is plumose. There are on the lateral aspect of the head three tufts of hairs, a small one immediately in front of the eye and a large one slightly posterior to the eye; the hairs constituting the tufts are simple; a short distance anterior to the small tuft of simple hairs is a well developed tuft of plumose

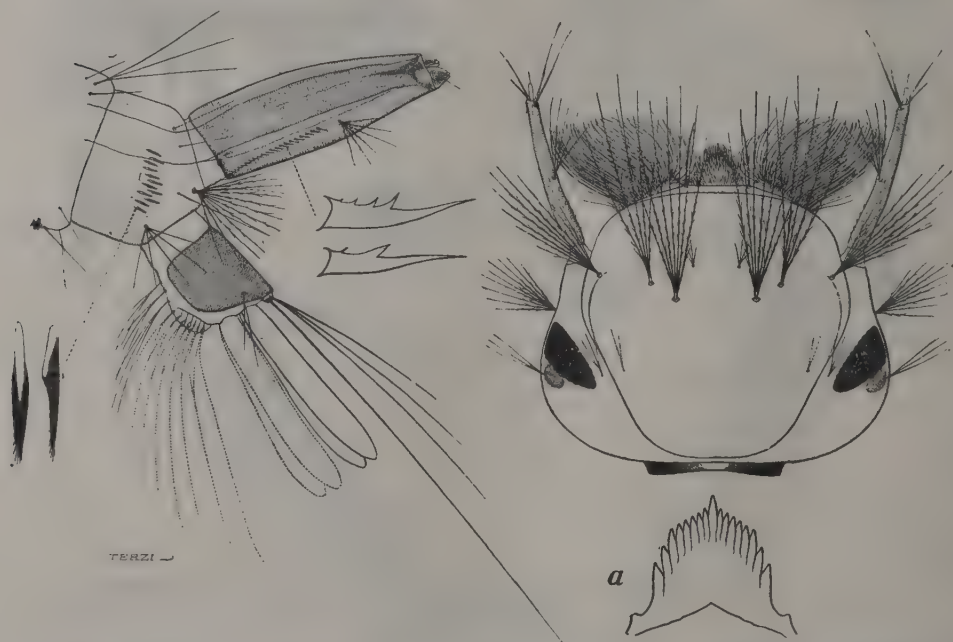


Fig. 4. Larva of *Ochlerotatus apicoannulatus*, Edw.; head and abdomen;
a, mental plate.

hairs situated more towards the ventral aspect of the head. The mental plate shows a stout median tooth with nine teeth on each side; these lateral teeth, which are pointed, increase in size towards the base of the plate.

The thoracic plumes are small. The lateral abdominal hairs are multiple on the first segment and paired on the other segments. The subsiphonal plume is formed of plumose hairs; the anal one apparently consists of simple hairs, and the siphonal seems to be represented by a single hair, but this is difficult to determine. The comb consists of 11-12 spines set in an irregular row. The siphon is about three times as long as the diameter of its base (55 units $\times$ 19) and carries a pecten of 18-20 barbed teeth, the last tooth being situated at about 23 units from the base of the siphon,

and a strongly developed tuft of six pubescent hairs is inserted at 28 units from the base. The valves are prominent. The anal segment is slightly longer than it is wide; it has a voluminous beard extending the whole length of the ventral surface, the hairs on the end of the dorsal surface being three above and one below, and there is a slender tuft of simple hairs on the lateral aspect of the segment immediately beneath the insertion of the dorsal hairs. Of two larvae examined, one showed no anal papillae and the other only one; this papilla was of extreme length, measuring about 48 units and having a pointed end.

The larva may be distinguished from other *Ochlerotatus* larvae (Edwards' key, Bull. Ent. Res., iii, p. 376) having multiple mid-frontal hairs and a pecten with about 18 teeth, by the number of teeth in its comb.

Breeding place.—The larvae were obtained from a hollow between the branches of a Flamboyant tree at Christiansborg, near Accra. The water collected in the hollow was dark brown in colour and contained rotting leaves and twigs. Larvae of *S. fasciata*, *S. metallica* and *S. luteocephala* were flourishing in the same situation.

Cyathomyia fusca, Theo. (fig. 5).

The head is about as wide as the thorax, and the frontal hairs are plumose. The antenna is rather slender, being covered with spicules, and carries its hair-tuft of simple hairs at five-sixths of its length. The eye is large. The mental plate has one very large mesial tooth, upon each side of which are four square-ended teeth and five sharply pointed teeth, these latter being nearest the base and the two most basal being larger than all the others except the mesial tooth.

The thoracic hairs on the dorsum are long and stout, but are scantily plumose. The lateral abdominal hairs are quadruple on the first segment and paired on the succeeding segments. The comb consists of about 35 long scales, which are fringed and are set in a triangular patch. The siphonal plume is formed of a few scantily plumose hairs with an independent hair adjacent; the subsiphonal plume consists of 6-8 plumose hairs, and one or two simple hairs constitute the anal plume. The siphon is about 12 times as long as the diameter of its base;* the pecten is composed of sharply pointed spines, 12-15 in number, and extends to about a quarter of the length of the siphon; beyond the pecten are 7-8 tufts of simple hairs, which are scanty, short, and irregularly placed. The anal segment measures about 20 units in length by 12 in width; its dorsal hairs are paired, two above and two below; the beard is rather poorly developed, and there is a small tuft of simple hairs on the lateral aspect just below the dorsal hairs. The anal papillae are unequal, the dorsal pair (41 units) are nearly twice as long as the ventral pair (24 units).

This larva may be distinguished from other *Culex* larvae possessing a siphon about 13×1 (Edwards' key, Bull. Ent. Res., iii, p. 381, and Bull. Ent. Res., vii, pp. 11-12) by its numerous comb scales (30-40) and by the absence of distally scattered pecten spines.

* In specimens dehydrated and mounted in balsam the length, however, is not more than ten times the diameter of the base.

Breeding place.—The larvae were found flourishing in the dark brown water that had collected in a hole partly filled with decaying vegetable matter in a Flamboyant tree (see Plate IV, fig. 1). With them were associated larvae of *A. costalis*, *A. marshalli*, *S. fasciata* and *S. luteocephala*.

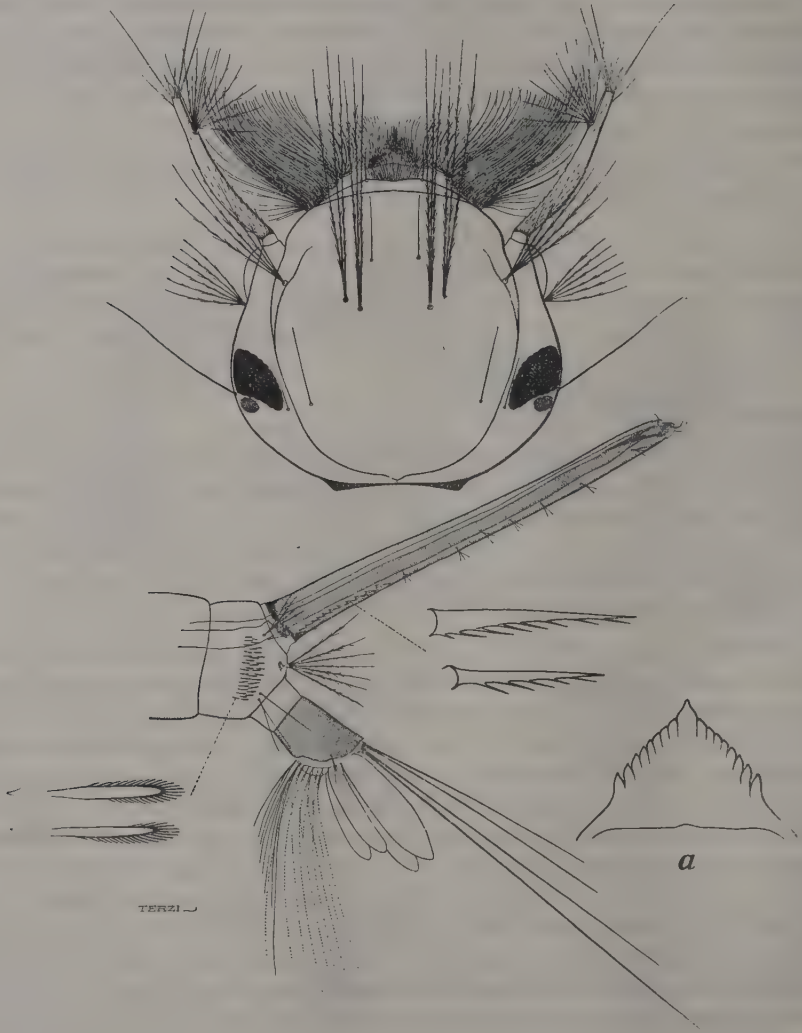


Fig. 5. Larva of *Cyathomyia fusca*, Theo.; head and end of abdomen;
a, mental plate.

***Eumelanomyia inconspicua*, Theo.**

In our former description of the larva of this species (Bull. Ent. Res., vii, p. 12) certain gaps had to be left owing to lack of sufficient material for examination. As we have been fortunate enough to procure further specimens, we are now able to complete the description.

The tuft on the antenna is usually situated at a point about four-fifths of the length from the base, and not about the middle as formerly stated. The mental plate, which resembles that of *Cyathomyia fusca*, has a very large median tooth, on each side of which are 8-9 teeth. These lateral teeth are larger towards the base of the plate, the four teeth nearest the central tooth are square-ended, the fifth tooth is in a transitional stage, and the four basal teeth are sharply pointed.

The lateral abdominal hairs are multiple on the first segment, triple on the second segment and double on the remaining segments. The dorsal hairs on the anal segment are one above and one below on each side. The anal papillae are unequal, the dorsal pair being nearly twice as long as the ventral, and as a rule the longest pair do not greatly exceed the length of the anal segment.

***Culex thalassius*, Theo. (fig. 6).**

The head is large, as wide as the thorax. The antenna is slightly curved and has spicules on its basal half and on the outer aspect of its apical part; it carries a tuft of plumose hairs just beyond the middle (17/28). The mid-frontal hairs and the tuft at the base of the antenna (ante-antennal plume) are strongly plumose. The mental plate has a substantial median tooth and eight sharply pointed teeth on either side. The eye is large, and the "larval" eye is in most specimens distinctly separate from the "imaginal" eye. The thoracic plumes are plumose and their insertion is marked by a chitinous plate. The longer lateral abdominal hairs are subplumose; they are quadruple on the first and second segments, and paired on the remaining segments. There are 60-70 scales in the comb; these are small, with a fringe of hairs, and are collected into a somewhat irregularly triangular patch. The hairs forming the siphonal and subsiphonal plumes are plumose, the anal plume appears to be formed of three or four pubescent hairs, which occasionally branch at their apices; in addition there is an independent hair between the anal and subsiphonal plumes. The siphon is nearly five times as long as the diameter of its base (83 units to 17); the pecten contains 12-15 barbed spines, beyond it being 4-5 pairs of strongly developed hair-tufts, while a smaller tuft is situated a short distance below the end of the siphon, and another smaller tuft is also to be seen laterally at a slightly lower level. The hairs in the larger tufts are pubescent apically. The anal segment is longer than it is broad and has a well developed beard; the hairs on the dorsal end are usually four above and one below on either side. A few small spines may be found on the end of the segment immediately beneath the dorsal hairs. The anal papillae are very short and oval in shape; they measure in length 10-12 units, as compared with the anal segment itself, which measures 30 units.

Eggs.—The eggs of *C. thalassius* are laid in a raft of the usual shape and size; they are a little more than four times as long as their greatest breadth. The surface of the egg shows cellular or reticular sculpturing.

Breeding place. The larvae appear to be unusually adaptable. They have been found flourishing in a variety of situations, such as a brackish lagoon, crab-holes, foul-smelling water holes, earth drains, pools of various sorts, an iron pot, and a spring. The first sample collected was found in a lagoon (see Plate III, fig. 2), the water of which contained 680 parts of chlorine per 100,000. The larvae were distributed along the edge in the shallow water, but did not frequent the deeper parts. They

occurred singly, drifting with the wind-swept water, and were very readily alarmed, when they sank at once to the bottom. The water in which they flourished was exposed to the full glare of the sun and was quite hot.

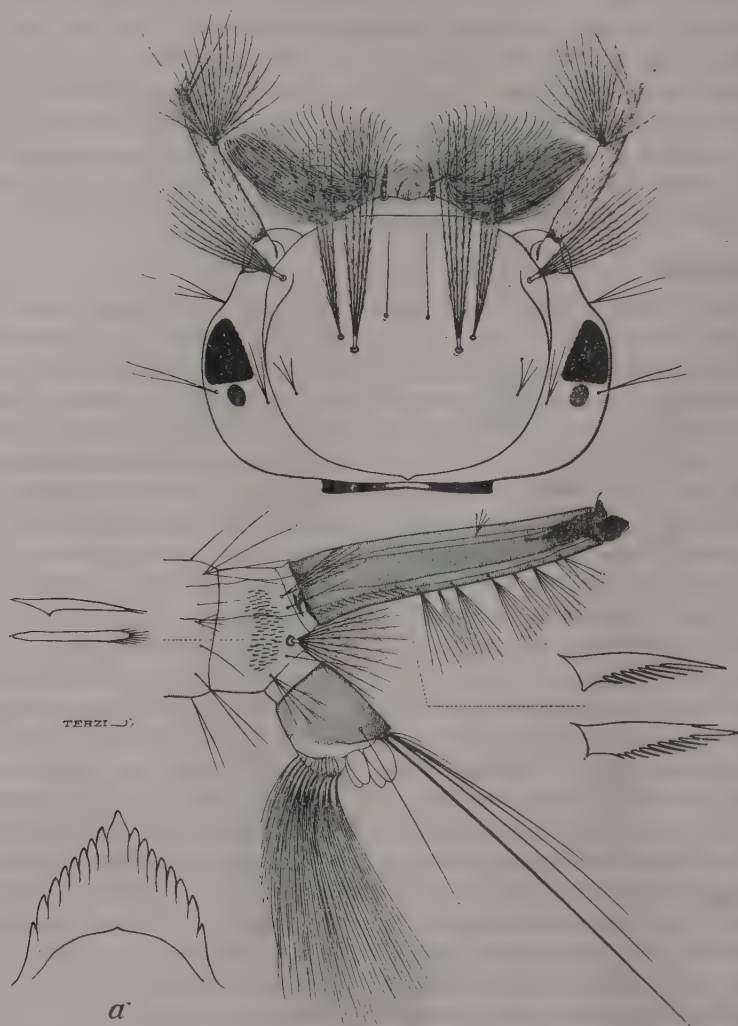


Fig. 6. Larva of *Culex thalassius*, Theo.; head and end of abdomen
a, mental plate.

Another sample was collected from a pool into which the sea poured at each high tide (see Plate III. fig. 1); a small crab found in this pool was a most voracious feeder on the larvae.

Other samples, however, were obtained from fresh-water pools, collections of rain-water, etc., so that a high degree of salinity is not essential for this species. No

difference in the length of the anal papillae or "tracheal gills" could be detected between the larvae found in the brackish and the fresh water.

The larvae were commonly found together with larvae of *A. costalis* and occasionally with those of *O. minutus*, *O. albocephalus*, *C. invidiosus*, *C. tritaeniorhynchus*, and *C. fatigans*. Larvae of *C. tigripes* var. *fuscus* were found preying upon them.

The imago is one of the most troublesome mosquitos in the bungalows at Accra and is a severe biter.

Culex tritaeniorhynchus, Giles.

This larva, which occurs in the same pools as the larva of *C. invidiosus*, resembles it closely in configuration. When the two larvae are examined side by side, however, that of *C. tritaeniorhynchus* seems to be more robust, to have a longer siphon and to be more strongly chitinised.

The head is large, almost as wide as the thorax. The antenna is covered with spicules, and its outer third beyond the insertion of the hair-tuft is much darker and has more prominent spicules than the basal two-thirds. The tuft of very plumose hairs is placed at two-thirds of the length of the antenna from its base. The mouth-brushes are prominent. The mid-frontal hairs are plumose, and the ante-antennal tuft is formed of dark and plumose hairs rising from a pedicle. The eyes are large. The mental plate shows a moderate-sized median tooth with 6-8 pointed teeth on either side, its posterior border being deeply incised mesially. The mandibular teeth are more powerfully developed than those of *C. invidiosus*.

The thorax carries the usual long plumes. The lateral abdominal hairs are sub-plumose and are multiple on the first segment, triple on the second segment and paired on the remaining segments. All the abdominal segments show stellate hairs, which are longer than the similar and similarly placed hairs on the abdomen of the larva of *C. invidiosus*. The comb comprises 35-40 fringed scales, which appear to be darker than the comb-scales of *C. invidiosus*. The siphonal and subsiphonal plumes are formed of plumose hairs, the hairs of the anal plume being simple. The siphon is about ten times as long as the diameter of its base; there are 10-12 spines, which are barbed inferiorly, in the pecten. The siphon also carries 6-8 pairs of tufts of simple hairs distally to the pecten; these tufts are longer than the tufts on the siphon of *C. invidiosus*, and those visible ventrally are more regularly placed in line. The anal segment is almost as wide as it is long (23 units : 21); the anal papillae are equal, have pointed ends, and are longer than the anal segment. The beard is fairly developed, and the dorsal hairs on this segment resemble the similar hairs on the anal segment of *C. invidiosus*.

This larva, as stated above, bears a striking resemblance to the larva of *C. invidiosus*, the apparently distinctive points have been tabulated below:—

	<i>C. tritaeniorhynchus</i> .	<i>C. invidiosus</i> .
Larva as a whole	.. More robust.	Less robust.
Antenna	 Apical portion above origin of hair-tuft darker and with more prominent spicules.	Apical portion scarcely darker, spicules not more prominent.

	<i>C. tritaeniorhynchus.</i>	<i>C. invidiosus.</i>
Lateral abdominal hairs	Paired after the first two segments.	Single after the first two segments.
Scales of comb	Darker in colour.	Lighter in colour.
Siphon	Ten times the length of its diameter at the base.	Eight times the length of its diameter at the base.
Hair-tufts beyond pecten	Hairs longer and tufts more or less regularly placed in a line.	Hairs shorter and tufts irregularly placed in a spiral.
Anal papillae	Nearly equal in length.	Ventral pair much shorter than dorsal.
Anal segment	Almost as broad as it is long.	Longer than broad.

Breeding place.—The larvae were found in large numbers in a swamp formed by the heavy rains in June and were associated with *A. costalis* and *C. fatigans*, and after a day or two larvae of *C. tigripes* var. *fuscus* were found preying upon them. They were particularly numerous at one part of the swamp where the water had submerged a narrow path through the grass. On re-examining the swamp a week later none of the larvae could be found, but on this occasion natural enemies (Ephemeroïd larvae, dragon-fly larvae, *Notonecta*, larvae of *Hydaticus* and other species of water-beetles, etc.), which had not been observed on the first occasion, were extremely numerous. On another occasion larvae of *C. tritaeniorhynchus* were found together with those of *C. invidiosus*, *C. thalassius*, and *A. costalis* in a large water-hole by the road-side. The water in this hole contained 18 parts of chlorine per 100,000.

Culex guiarti, Blanch.* (fig. 7).

The head is as wide as the thorax and is strongly chitinised. The antenna is slightly curved and stout; on its surface a few spicules occur, most conspicuously at its base. The antennal tuft, which is placed at about three-fourths of the length of the antenna from its base, consists of dark and plumose hairs. The apical portion of the shaft beyond the hair-tuft is considerably darker than the basal three-fourths. The mid-frontal hairs are plumose and paired, the ante-antennal tuft being formed of dark and plumose hairs. The brushes are strongly developed and the palps are large. The eye is large and band-like, extending on to both the dorsal and ventral surfaces. The "larval" eye is small and round, lying below and separated from the main eye. The mental plate is small, consisting of one stout median tooth with six or seven more slender teeth on each side.

The dorsal thoracic plumes are formed of subplumose hairs, those on the anterior border being very long; the ventral thoracic plumes are formed of plumose hairs. The lateral abdominal hairs are multiple on the first segment, quadruple on the second and triple on the remainder. Plumose hairs form the siphonal and sub-

*The adults associated with two other larvae have also been identified as *C. guiarti* (Bull. Ent. Res., vii, p. 7, footnote). It is not possible to decide at present whether this is due to some error in association, or to the name *C. guiarti* including more than one species of mosquito.

siphonal plumes, while three or four pubescent hairs and an independent hair detached towards the subsiphonal plume represent the anal plume. The comb consists of 7-8 stout spines placed in an irregular row. The siphon is nearly nine times as long as the diameter of its base and carries a pecten of 8-9 rather slender



Fig. 7. Larva of *Culex guiarti*, Blanch.; head and end of abdomen;
a, mental plate.

spines, fringed at their bases. Four or five tufts formed of two to three simple hairs are visible beyond the last spine of the pecten. The anal segment is nearly twice as long as it is broad (30 : 16 units); the beard is somewhat scanty, but the dorsal

hairs are well developed, consisting of three hairs above and one below on each side. The anal papillae are slightly longer than the anal segment (35 : 30 units) and are subequal with rather pointed ends.

This larva may be distinguished from other *Culex* larvae having siphon tubes 8×1 by the possession of a comb consisting of 7-8 spines (Edwards' key, Bull. Ent. Res., iii, pp. 380-381).

Breeding place.—These larvae were found at Nsawam (Plate I, fig. 1), 25 miles north of Accra, in a swamp (covered with *Pistia stratiotes*) which lies on both sides of the railway embankment, and were associated with the larvae of *Mansonioides africanus* and *Mimomyia splendens*.

***Mimomyia splendens*, Theo. (fig. 8).**

The larva resembles those of *Mimomyia hispida* and *M. mimomyiaformis* in the shape of its antennae and in the hirsute appearance of its head.

The head is dark and large, though not so broad as the thorax. The antennae are curved, with a tuft of plumose hairs at about two-thirds of the basal portion; they are possessed of divergent apical pieces similar to those of *M. hispida* and *M. mimomyiaformis*, these pieces being devoid of the spicules present on the basal portions, and at their junction with the basal portions are two long bristles. The apical piece in this larva does not appear to be lighter in colour than the rest of the antenna. A bifurcated subplumose hair extends laterally from the head in front of the eye, as in *M. hispida*, and there is a small plume of simple hairs on the dorsal surface of the head immediately internal to the eye. The mental plate is small and flat, with a central tooth and six teeth on each side, the outermost of which are the smallest. All the frontal hairs are strongly plumose, the ante-antennal plumes resembling feathers.

The long hairs on the thorax are plumose. The lateral abdominal hairs on the first two segments are multiple, large and plumose, those on the remaining segments being plumose, small and paired; and on all the abdominal segments there are conspicuous stellate hairs. The comb consists of a single row of large spines, 6-7 in number. The siphon is about three times as long as the diameter of its base, the pecten being formed of two spines, which are placed vertically and not horizontally as in *M. hispida*. There is a hair-tuft of subplumose hairs about the middle of the siphon and a pair of hooks on the dorsal valves. The subsiphonal plume is formed of subplumose hairs, the hairs of the siphonal plume being pubescent, while the anal plume consists of simple hairs; there are also two independent hairs, which are branched, on each side of the subsiphonal plume. The anal segment is longer dorsally than ventrally, has its posterior border edged with spicules, long and short spicules alternating, and possesses a single long and subplumose hair on its lateral aspect. The dorsal hairs are collected into tufts and are more strongly developed than the beard. The anal papillae are short, nearly equal in length (the ventral pair being slightly longer), and have pointed extremities; they are about half the length of the anal segment.

This larva may be distinguished from the larva of *Mimomyia mimomyiaformis*, which also possesses an antenna with a divergent apical piece and a comb of 6-7 spines in a single row, by its pecten of relatively strongly developed spines.

Breeding place.—The larvae were found in a small pool covered with the water-weed *Pistia stratiotes* (see Plate II, fig. 1) and were repeatedly obtained from the same pool from February to July. With them were associated the following larvae:—*A. costalis*, *Aëdeomyia africana*, *Culex quasigelidus* and *Mansonioides africanus*.

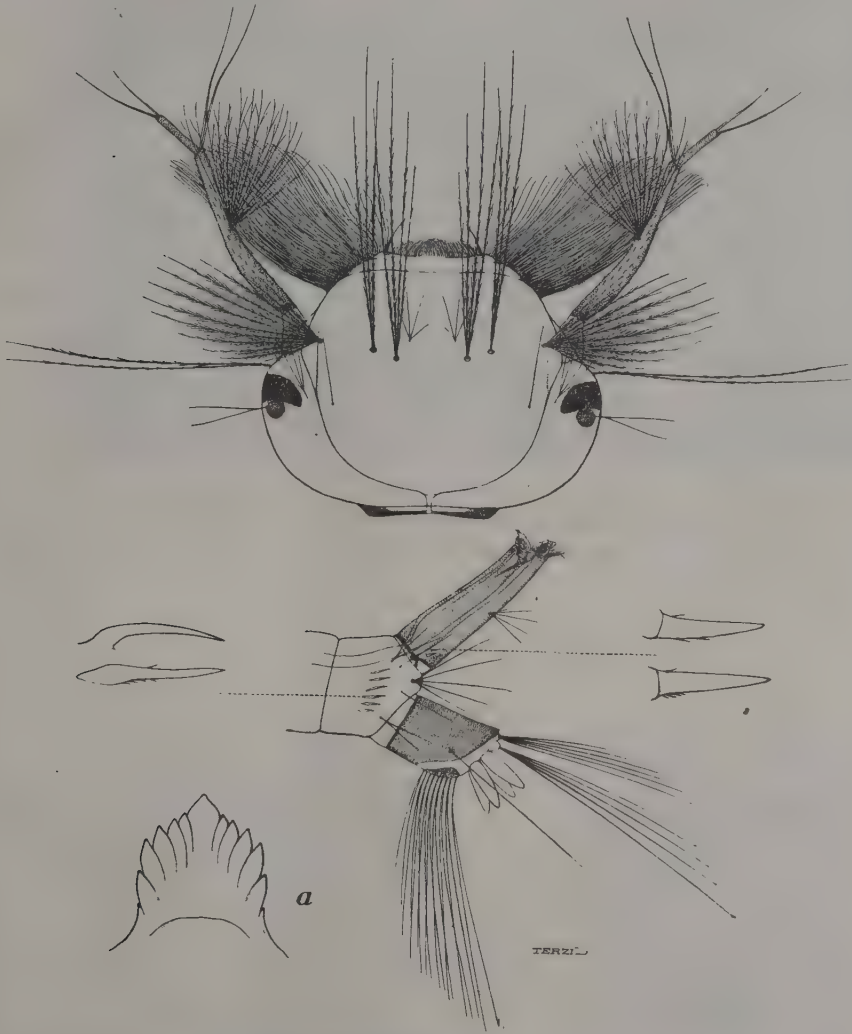


Fig. 8. Larva of *Mimomyia splendens*, Theo.; head and end of abdomen;
a, mental plate.

The larvae were very active in their movements, but when stationary lay practically parallel with the surface of the water. They appeared to be definitely associated with the weed *Pistia stratiotes*, as they were generally found under the leaves of this plant.

The leaves of *P. stratiotes* have an unwettable surface and are strongly ribbed on the underside, so that as the plant expands the outer leaves come in contact with the surface of the water and carry down with them a film of air. It was to the underside of these outer leaves that the larvae of *M. splendens* attached themselves, lying horizontally with their siphons inserted into the film of air, and in maintaining this position the hooks described above were no doubt of great assistance. In this manner they were able to live for a long time (in one experiment 24 hours) without direct access to the air and may moult whilst still submerged.

***Chaoborus ceratopogones*, Theo.**

The head is small and laterally compressed, as compared with the head of a larva of the CULICINAE, and carries very few hairs. Two delicate tufts of simple hairs are visible, one in front of and one behind the prominent eye. The mouth-parts described by Miall ("Aquatic Insects" pp. 116-117) are very well seen in the larval pelt. There is a distinct neck.

No plumes are present on the thorax, but on its lateral aspect short tufts of simple hairs occur and dorsal to these hair-tufts a single longer hair.

The abdominal segments have laterally a single long hair and a tuft of simple hairs ventral to this hair similar to the arrangement of the lateral hairs on the thorax. The usual paired and pigmented air sacs are present in the thorax and the seventh abdominal segment. The ventral brush on the ninth segment is composed of about 20 curved and elegantly plumose hairs. The anal papillae are short, the ventral pair being slightly longer than the dorsal. The hairs on the dorsal extremity of the ninth segment are one above and one below; they are nearly equal in length and are strongly plumose.



Fig. 1. Swamp at Nsawam partly covered with *Pistia* plants; breeding place of *Culex guiarti* and *Mansonioides africanus*.



Fig. 2. First stage larva of *Mansonioides africanus*.

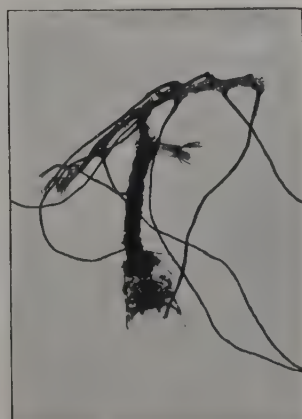


Fig. 3. Larva of *M. africanus* attached to roots of *Pistia*.





Fig. 1. Pool covered by the water-weed *Pistia stratiotes*; breeding place of *Anopheles costalis*, *A. marshalli*, *Aedomyia africana*, *Culex quasigelidus*, *Mansonioides africanus* and *Mimomyia splendens*.



Fig. 2. Crab-hole at the margin of a lagoon; breeding place of *Culex thalassius* and *Ochlerotatus minutus*.





Fig. 1. Pool flooded by the sea at high tide, in which larvæ of *Anopheles costalis* and *Culex thalassius* were found.



Fig. 2. Lagoon at Christiansborg, near Accra; breeding place of *Culex thalassius*.





Fig. 1. Flamboyant tree with a hole in the main fork in which were larvæ of *Anopheles costalis*, *A. marshalli*, *Stegomyia fasciata*, *S. luteocephala* and *Cyathomyia fusca*.



Fig. 2. Flamboyant tree with a hole in which occurred larvæ of *Stegomyia unilineata*, *S. simpsoni*, *S. metallica* and *S. luteocephala*.



A SUMMARY OF OUR KNOWLEDGE OF INSECT VECTORS OF DISEASE.

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Wellcome Bureau of Scientific Research.

So much has been said about insects since the War began that it is, I think, advisable that some attempt should be made to summarise our knowledge of the more important insect-borne diseases and their vectors. While insects have long been suspected of being responsible for the transmission of serious diseases, it may be said that practically the whole of our knowledge of insects in this rôle has been acquired within the past twenty years. So rapidly, however, has the charge on this offence been made out against them that, although it is common knowledge that they have been proved guilty, it is not generally realised upon how many counts the verdict rests.

It has lately been my good fortune to give class instruction for the War Office to officers of the R.A.M.C. who are proceeding to the East, and in order to bring home to my audience the importance of the connection between insects and disease I have compiled the tables which I now publish. These can in no way claim to be complete, but merely present the more important insect-borne diseases, including human diseases that on certain grounds are suspected of having insect vectors. With these tables I also publish one (Table VI) which includes the chief insects and Acarina that are directly the cause of disease in man and his domestic animals. To complete the list of insect-transmitted diseases would demand the consideration not only of other mammals as hosts, but also of avian and reptilian hosts. In the present instance this would be to carry the subject beyond general interest, but it must be remembered therefore that, long as the present list of charges is, insects are not here arraigned on all the counts that might with justice be preferred against them.

During the last few years medical entomology has been rapidly establishing itself as an invaluable branch of preventive medicine, and with the outbreak of the present war a great deal of interest and study has been devoted to this subject in Europe, notably in connection with the transmission of typhus fever by lice, and the dissemination of bacteria and other organisms by flies.

Centuries ago insects were suggested as being possibly concerned in the spread of disease, and from time to time such logical hypotheses were advanced that it is surprising that the establishment of the truth was not sooner forthcoming. In 1577 Mercurialis, an Italian physician, suggested that plague, which was then ravaging Europe, was spread by flies feeding upon the diseased and dead, and later depositing faecal matter on food consumed by healthy persons. This idea held ground, and various suggestions occur as to the spread of disease by flies in the literature of the XVIIIth century. Edward Bancroft in 1769 advanced the theory that yaws was transmitted by flies feeding on diseased subjects and carrying the contagion by settling on open wounds or scratches on healthy persons. In 1848 Dr. Josiah Nott, of Mobile, Alabama, published a remarkable article in which he gave reasons for supposing that yellow fever was an insect-borne disease; but although he mentioned many insects, he did not specify any one as the particular vector.

The connection between malaria and the mosquito had long been held, it is said, by the Italian and Tyrolese peasants, and even by the natives of East Africa, but the first charge brought against the mosquito in the spread of disease, by scientific authority, was in connection with yellow fever. In 1853, Dr. Daniel Beauperthuy, a French physician, wrote ably arguing that yellow fever and other fevers were transmitted by mosquitoes, but in those days there being no accepted belief in a *contagium vivum*, he concluded that the virus was obtained from decomposing material that the mosquito had consumed and that was later accidentally inoculated into man. Raimbert, in 1869, showed by experiment that anthrax could be disseminated by flies.

Epoch-making in the history of our knowledge of insect vectors was Manson's discovery, in 1878, that *Filaria bancrofti* was spread by mosquitoes; but at first he thought the *Filaria* escaped from the insect into water and reached man in this manner. Later work by Manson and his colleagues determined the exact means of transmission.

It was not until 28 years after Beauperthuy's theory that Charles Finlay, an American of Havana, definitely attributed, in 1881, the transmission of yellow fever to a mosquito of a definite species. He had noticed the connection that seemed to exist between the presence of large numbers of *Stegomyia fasciata* and the prevalence of yellow fever. He then attempted to transmit the disease experimentally by the bites of this mosquito, and whilst his experiments are open to criticism, there is no doubt that he did succeed in doing so.

Three years later, in 1883, another American, A. F. A. King, advanced the first well-formulated mosquito-malaria theory, and in 1898 Ross, in India, demonstrated beyond doubt the important rôle played by mosquitoes in the transmission of malaria.

In 1899 the American Yellow Fever Commission (Reed, Carroll, Lezear and Agramonte) was sent to Cuba and was there able to demonstrate with certainty that yellow fever is transmitted by *S. fasciata*.

It is interesting thus to note the almost parallel development in time of our knowledge of two of the most important insect-borne diseases. To deal even briefly with the historical aspects of our knowledge of other diseases tabulated below would be to consume a large amount of space, and the foregoing account will have indicated the path that has led to subsequent discoveries whose histories are readily available.

I will pass therefore to a few notes on each of the Tables.

Notes to Table I.—Diseases of Unknown Origin.

The majority of these diseases are doubtless caused by living viruses, often organisms of ultra-microscopic size, and commonly referred to as "filterable viruses."

In the case of pellagra it would appear, however, from the most recent work that although it is still considered by many persons to be possibly an insect-borne disease (and according to Sambon having a likely vector in either the CERATOPOGONINAE or SIMULIIDAE) Goldberger in America considers it a disease now certainly attributable to vitamin-starvation through an unbalanced diet. If this is the case, there is no causative organism and no vector, and pellagra should be ruled out of present consideration. The question nevertheless is by no means settled.

The virus of acute anterior poliomyelitis is still not isolated with certainty. Flexner and his colleagues have been able to cultivate a filterable micro-organism which produced the disease in experimental animals, and more recently Rosenow and his fellow-workers have isolated a polymorphous streptococcus with which they were also able to produce paralysis in certain animals. Nuzum and Horzog were able to do likewise by a gram-positive micrococcus isolated from the brain and spinal chord of persons dead from the disease. Poliomyelitis has been very generally suspected of being transmitted by insects, particularly by *Stomoxys calcitrans* (the stable fly), fleas, and TABANIDÆ (gad-flies). Nevertheless it appears more likely that it has an aerial transmission, infection being acquired through the buccal and nasal mucous membranes.

Wolbach claims to have discovered the causative organism of Rocky Mountain spotted fever in the bodies of infective ticks (*Dermacentor venustus*).

TABLE I.

The more Important Insect-borne Diseases of Unknown Origin.

(N.B.—Names in these tables marked with an asterisk are certain vectors ; names not so marked are probable vectors ; names followed by (?) are possible vectors.)

Organism.	Host.	Disease.	Vector.
?	Man.	Dengue, or breakbone fever.	Sandflies (<i>Phlebotomus</i>),* mosquitoes (<i>Culex fatigans</i>).*
?	"	Three-day fever (sandfly fever, <i>Phlebotomus</i> fever).	Sandflies (<i>Phlebotomus</i>),* mosquitoes (<i>C. fatigans</i>).*
?	"	Yellow fever.	Mosquitoes (<i>Stegomyia fasciata</i>).*
?	"	Trench fever.	Lice (?).
? Salivary toxin	"	Tick paralysis (American).	Ticks (<i>Dermacentor venustus</i>).*
? Salivary toxin	"	Tick paralysis (Australian).	Ticks (<i>Ixodes ricinus</i>).*
?	"	Rocky Mountain spotted fever.	Ticks (<i>Dermacentor venustus</i>).*
?	"	Japanese river fever (Shima mushi).	Mites (Larval Trombidiidae, "aka mushi").
?	"	Acute anterior poliomyelitis (infantile paralysis).	Many insects have been claimed as vectors, notably <i>Stomoxys calcitrans</i> (?).
?	"	Pellagra.	Flies of the genus <i>Simulium</i> (?) have been claimed.

Notes to Table II.—Diseases of Bacterial Origin.

In the majority of cases, diseases of this class have an *indirect* transmission by insects, that is to say, instead of the organism entering the body of the host through inoculation by the bite of an insect (*direct* transmission), the organisms are carried in or on the insect's body, and are deposited by contact on human food or skin abrasions, and in this manner cause infection.

Bacillus tuberculosis may be disseminated by house-flies feeding on infective sputum, as was first shown by Spillman and Haushalter (1887) and subsequently by the investigations of other workers. With the high vitality and resistance to drying possessed by *B. tuberculosis*, the possibly long incubation period within the body, and the insidious onset of the disease, the danger from *Musca domestica* in this connection is still not sufficiently recognised.

Exceptions to the rule of indirect transmission are plague, transmitted by the bite of certain fleas, and typhus that has direct transmission through the bite of lice. Direct transmission by insects of bacterial diseases may possibly also occur in certain instances in the spread of tuberculosis and leprosy.

If Wolbach's organism (see Table I. and notes thereto) is proved to be the cause of Rocky Mountain spotted fever, this will also be a disease of bacterial origin with direct transmission through a tick, *Dermacentor venustus*.

TABLE II.

The more Important Insect-borne Diseases of Bacterial Origin.

(The word "Flies" in these tables includes:—*Musca domestica*, *Fannia* spp., *Calliphora* spp., *Lucilia* spp., and *Sarcophaga* spp.)

Organism.	Host.	Disease.	Vector.
<i>Bacillus anthracis</i> ..	Man and animals.	Anthrax	Flies, Tabanidae (?), beetles (?).
„ <i>dysenteriae</i> ..	Man	Bacillary dysentery	Flies (<i>Musca domestica</i> , <i>Calliphora</i> spp., <i>Lucilia</i> spp.).*
„ <i>leprae</i> ..	Man	Leprosy	Flies (?), fleas (?), bedbugs (?), skin mites (?), mosquitoes (?).
„ <i>paratyphosus</i> A. .	Man	Paratyphoid fever	Flies.*
„ <i>paratyphosus</i> B. .	Man	„ „	Flies.*
„ <i>pestis</i>	Man and rats.	Plague	Fleas.*
„ <i>tuberculosis</i> ..	Man and animals.	Tuberculosis	Flies, cockroaches, fleas (?), bed-bugs (?).
<i>Rickettsia prowazeki</i> , <i>typhi-exanthematici</i> } Plötz's organism }	Man	Typhus fever	Lice.*
<i>Bacillus typhosus</i> ..	Man	Typhoid fever	Flies.*

TABLE II—*cont.*

Organism.	Host.	Disease.	Vector.
<i>Bartonella bacilliformis</i> ..	Man	Verruga	<i>Phlebotomus verrucarum</i> .*
<i>Spirillum cholerae</i> ..	Man	Cholera	Flies,* cockroaches, ants.
<i>Micrococcus melitensis</i> ..	Man and goats.	Undulant fever (Malta fever, Mediterranean fever, remittent fever).	Flies,* although the main channel of infection is the consumption of goat's milk.*
<i>Diplococcus intracellularis</i>	Man	Cerebro-spinal fever	Flies (?).
<i>Diplococcus pemphigicongiosii</i> .	Man	Tropical impetigo	Lice.*

Notes to Table III.—Diseases of Spirochaetal Origin.

With these diseases the usual method of transmission is direct, that is to say, through the bites of the insect vectors. A possible exception occurs in the case of yaws, where *Musca domestica* may at times convey the organism from diseased to healthy persons.

TABLE III.

The more Important Insect-borne Disease of Spirochaetal Origin.

Organism.	Host.	Disease.	Vector.
<i>Spirochaeta carteri</i> ..	Man	Indian relapsing fever.	Lice.*
„ <i>duttoni</i> ..	Man	African relapsing fever (tick fever).	Ticks (<i>Ornithodoros moubata</i> ,* <i>O. savignyi</i>).*
„ <i>gallinarum</i> ..	Fowls	Spirochaetosis	<i>Argas persicus</i> .*
„ <i>novyi</i> ..	Man	American relapsing fever.	Lice.*
„ <i>pertenuis</i> ..	Man	Yaws (Framboesia)	Flies (?).
„ <i>recurrentis</i> ..	Man	European relapsing fever.	Lice,* bed-bugs (?).

Notes to Table IV.—Diseases of Protozoal Origin.

Both direct and indirect methods of transmission by insects occur with diseases of this class. With the intestinal parasites indirect transmission takes place by the flies feeding on faeces containing the resistant stages (cysts), and later depositing them on human food and drinking water either by regurgitation of the stomach contents or per anum. Needless to say, infection also occurs—and perhaps principally—by mechanical and aerial transmission of the cysts to food and water.

The majority of the protozoal blood-parasites have insect vectors, on which they depend solely for transmission, and in certain cases these vectors are specific: Malaria—*Anopheles*; sleeping sickness *Glossina*; European relapsing fever—*Pediculus*. Other insect-borne blood protozoa are apparently able to be transmitted by more than one vector; e.g., kala-azar may be carried by bed-bugs (Patton), or by *Triatoma rubrofasciata* (Donovan); and souma (trypanosomiasis) may be carried by *Glossina*, or by *Stomoxys calcitrans*.

TABLE IV.

The more Important Insect-borne Diseases of Protozoal Origin.

Organism.	Host.	Disease.	Vector.
<i>Entamoeba histolytica</i> ..	Man	Amoebic dysentery	Flies.*
<i>Lamblia intestinalis</i> ..	Man	Flagellate dysentery	Flies.*
<i>Plasmodium malariae</i> ..	Man	Quartan malaria	Anopheline mosquitoes.*
„ <i>vivax</i> ..	Man	Benign tertian malaria.	Anopheline mosquitoes.*
„ <i>falciparum</i> ..	Man	Malignant or sub-tertian malaria.	Anopheline mosquitoes.*
<i>Leishmania tropica</i> ..	Man	Oriental sore	Flies, fleas, <i>Phlebotomus</i> (?), <i>Hippobosca</i> (?).
„ <i>donovani</i> ..	Man	Kala-azar	Bed-bugs (?), fleas (?), <i>Triatoma</i> (?).
„ sp. inc. ..	Man	Espundia	Probably some tropical blood-sucking insect.
„ <i>infantum</i> ..	Children	Leishmaniasis	Fleas.
<i>Trypanosoma gambiense</i> ..	Man	Congo sleeping sickness.	Tsetse-flies (<i>Glossina palpalis</i>).*
„ <i>rhodesiense</i> ..	Man	Rhodesian sleeping sickness.	<i>Glossina morsitans</i> .*
„ <i>brucei</i> ..	Cattle and horses.	Fly sickness (Nagana).	<i>Glossina morsitans</i> .*
„ <i>lewisi</i> ..	Rats	Rat trypanosomiasis	Rat louse (?), and fleas (<i>Ceratophyllus fasciatus</i> , <i>Ctenocephalus canis</i>).*
„ <i>evansi</i> ..	Horses, mules, camels.	Surra	Horse-flies (<i>Tabanus striatus</i>).*
<i>Schizotrypanum cruzi</i> ..	Man	Chagas's disease	<i>Triatoma</i> (<i>Conorhinus</i>) <i>megistus</i> .*
<i>Babesia bigeminum</i> ..	Cattle	Red-water fever	Ticks (<i>Margaropus annulatus</i>).*
„ <i>ovis</i> ..	Sheep	Piroplasmosis	Ticks (<i>Rhipicephalus bursa</i>).*
„ <i>canis</i> ..	Dogs	Malignant jaundice	Ticks (<i>Rhipicephalus sanguineus</i> , <i>Haemaphysalis leachi</i>).*
„ <i>caballi</i> ..	Horses and mules.	Piroplasmosis	Ticks (<i>Dermacentor reticulatus</i>).*
<i>Nuttallia equi</i> ..	Horses and mules.	Piroplasmosis	Ticks (<i>Rhipicephalus evertsi</i>).*
<i>Chlamydozoa</i> (?) ..	Man	Ophthalmia aegyptica.	Flies.*

Notes on Table V.—Diseases of Helminthal Origin.

With the exception of possible infection with certain helminths resulting from the carriage by flies of helminth ova from faeces and subsequent deposition of the ova on food, the insect-borne helminths all undergo part of their life-history in the body of the insect vector. Thus the adult *Filaria bancrofti* live in the lymphatic glands. The ova find their way into the blood stream, where on hatching they are known as microfilariae, and some are taken up from the blood when a mosquito bites a person harbouring the organisms. These, if they have entered the stomach of *Culex fatigans*, or other intermediate host, soon make their way to the thoracic muscles of the mosquito, where they undergo definite metamorphosis. When this is complete (usually in from 16 to 20 days) the worms make their way into the mosquito's proboscis, and when next it pierces the skin of some victim the filariae burst through the proboscis-sheath and make their own passage through the skin, from which they soon travel to some lymphatic gland, where they become sexually mature, and the cycle is repeated. Similarly *Dipylidium caninum* passes part of its life-history in the rat flea, and becomes sexually mature in the dog or man. The ova are ingested by the larval flea, and infection by the cysticeroid stage follows the accidental ingestion of the flea by the definite host.

TABLE V.

The more Important Insect-borne Diseases of Helminthal Origin.

Organism.	Host.	Disease.	Vector.
<i>Dipylidium caninum</i> ..	Man and dog.	Taeniasis (tape-worm).	Dog louse (<i>Trichodectes latus</i>),* dog flea (<i>Ctenocephalus canis</i>).*
Ova of certain helminths	Man	Helminthiasis (parasitic worms).	Flies.*
<i>Microfilaria bancrofti</i> ..	Man	Filariasis (elephantiasis).	Mosquitoes (<i>Culex</i> , <i>Stegomyia</i> , <i>Anopheles</i>).*
<i>Loa loa</i>	Man	Calabar swellings	House-flies (<i>Chrysops dimidiata</i>).*
<i>Filaria immitis</i>	Dog	Log filariasis	Mosquitoes (<i>Culex</i> , <i>Anopheles</i>).*

Notes to Table VI.—Diseases directly attributable to Insects and Acarina.

In each case the disease results from the damage done by the insects and Acarina in adopting existence upon the body of the host and living upon its tissues. The time spent upon the host may cover the whole life-history of the parasite and many subsequent generations, as with *Sarcoptes scabiei* and the *Pediculi*, or may only embrace part of the parasite's development, as with the larvae of flies causing myiasis. In either case the injury to the host may be so extensive as to cause death from the loss of vital tissue, or the injury itself, although insignificant, may indirectly cause death to the host by providing a suitable path for invasion by pathogenic micro-organisms.

TABLE VI.

The more Important Diseases Directly Attributable to Insects and Acarina.

Organism.	Host.	Disease.
<i>Fannia canicularis</i>	Man	Intestinal myiasis
<i>Piophilæ casei</i>	Man	" "
<i>Eristalis tenax</i>	Man	" "
<i>Muscina stabulans</i>	Man	" "
<i>Sarcophaga</i> spp.	Man	Intestinal, dermal and muscular myiasis.
<i>Lucilia</i> spp.	Man	Intestinal, dermal and muscular myiasis.
<i>Calliphora</i> spp.	Man	Intestinal, dermal and muscular myiasis.
<i>Chrysomyia macellaria</i> (screw worm).	Man and animals.	Nasal, auricular, and dermal myiasis.
<i>Cordylobia anthropophaga</i> ..	Man	Dermal myiasis.
<i>Dermatobia hominis</i>	Man	" "
<i>Hypoderma bovis</i> , etc. ..	Cattle (occasionally Man)	" " (Creeping disease in Man).
<i>Oestrus ovis</i>	Sheep (rarely Man).	Nasal myiasis.
<i>Gastrophilus equi</i> , etc. ..	Horses (rarely Man).	Gastric myiasis.
<i>Trombidiidae</i> (Harvest Mites)	Man	Severe cutaneous irritation.
<i>Pediculoides ventricosus</i>	Man	Dermatitis.
<i>Tyroglyphus siro</i>	Man	Dermatitis (the so-called "vanilism.")
<i>Tyroglyphus longior castellanii</i> ..	Man	Copra itch.
Other <i>Tyroglyphidae</i>	Man	Dermatitis (Grocers' itch).
<i>Sarcoptes scabiei</i>	Man and animals.	Itch or scabies.
<i>Pediculus capitis</i>	Man	Pediculosis.
,, <i>humanus</i>	Man	"
<i>Phthirus pubis</i>	Man	"
<i>Dermatophilus penetrans</i> (chigger)	Man and animals.	Severe cutaneous irritation, which leads ultimately to inflammation and ulceration.

The Larvæ of

TABLE VII.

The more Important Insect-borne Diseases of Fungus Origin.

Organism.	Host.	Disease.	Vector.
<i>Achorion schönleinii</i>	Man	Favus	Lice (<i>Pediculus</i>).*

Conclusion.

It should be borne in mind that a large number of diseases included in the foregoing Tables are not spread by insects alone, and insect transmission may in some cases be only occasional. This fact, however, does not justify the exclusion of such diseases from consideration, and where transmission of the indirect type is possible, it is obvious that we are unable to form any just estimate of its relative importance. Probably nevertheless the dissemination of pathogenic micro-organisms by flies, for all that has lately been said in this connection, has not even yet been over-emphasised. It seems more than likely that *Bacillus tuberculosis* is spread in this manner from infective sputum to food (milk particularly) to a much greater extent than is commonly imagined, and there being no probability of rapid acute infection, as with *B. typhosus*, the part played by the fly is too apt to be over-looked.

Much of our knowledge with regard to insects and disease is still indefinite, as may be seen from the Tables, but to anyone not particularly conversant with the subject, what we already know with certainty, even in connection with only the more important diseases that have been considered, may be sufficient to cause some little surprise.

THE WESTERN AND NORTHERN LIMIT OF *GLOSSINA MORSITANS* IN NORTHERN KATANGA¹

By Dr. SCHWETZ.

(MAP I.)

It is not necessary to insist on the utility of knowing the exact distribution of *Glossina morsitans*. While its rôle in the etiology of human trypanosomiasis is not yet fully established, and does not seem to be very important, the same unfortunately cannot be said of animal trypanosomiasis. The obstacle presented by *G. morsitans* to the breeding of cattle is well known, and the study of the distribution of this fly is therefore of considerable interest and importance from several points of view, entomological, medical and economic.

In a previous paper on this subject (Bulletin of Entomological Research, December 1915) I stated the results of my observations, namely, that this *Glossina* inhabits only regions where the vegetation is of a particular type, namely, bush or park-like country. On several journeys made in 1913 and 1914 between the River Lualaba and the River Lomami in the region between 9° and 6° S. Lat., I was able to define the spots where the park-like country and *G. morsitans* disappear almost simultaneously. These spots I described as the western limit of *morsitans*. I also drew attention to the fact that between 8° and 6° S. Lat. this double limit coincided more or less with the line of the Lualaba-Lomami watershed. But by a scientific scruple I abstained from giving on the map an approximate, theoretical line for this limit and confined myself to indicating the districts actually visited and examined. In the course of 1916 I again made several journeys between the Lualaba and the Lomami, and again determined several points in the western limit of *morsitans*. I am therefore now able to complete the former map. This time I have also found the northern limit of *morsitans*. I will explain briefly the result of each of my recent journeys (see Map).

From Kabonga to Katombe.

Grassy savannah, here and there more or less wooded, as far as the village Mlenge before the River Lugufu. Then, as far as the village Ngona (River Sangwa Mbusi) transitory vegetation: grassy savannah, scrub, patches of thin park-land (parc dégénéré), tracts of forest. After the Sangwa Mbusi comes a stretch of typical park, which, however, is not continuous as far as Katombe, being interrupted here and there by more or less long stretches of thin park, wooded savannah and several other kinds of transitory vegetation.

I would draw attention to two points that can be noticed in studying the map. First, that from the River Luguvu, after the village Mlenge, the basin of the Lomami is left, the streams and rivers that follow being intermediary tributaries of the Lualaba. Second, that the Kabongo-Katambe route is parallel to that from Kabongo to Kisengwa; but while the latter follows the basin of the Lomami, the former leaves it after the River Luguvu. But the park commences at exactly 15 km. after

the line of the watershed, while the surroundings of the Kabongo-Kisengwa route are still savannah. In other words, the park begins (or ends) here close to the line of the Lualaba-Lomami watershed.

As regards *G. morsitans*, I must admit that the result was somewhat unexpected. I found the species only in small numbers, and not ubiquitous. Theoretically, *morsitans* exists more or less in all parts after the village Gona; but it is very rare everywhere. I found it in fair quantities between the villages Gona and Kataba, and in very small numbers around the village Mbaie and between Mbaie and Minda. I think the reason is that from Gona to Katombe the western side of the park is followed, and I have already noted in my preceding paper the fact that *G. morsitans* sometimes disappears a little before the final termination of the park.

I would say in passing that I found two other species of *Glossina* throughout the route after Gona, namely, *G. brevipalpis* (fair number) and *G. pallidipes* (small number).

From Katombe to Kabala.

Generally park country, but thin in some places, here and there several large clearings. *G. morsitans* throughout the route (in fair numbers), and *brevipalpis* and *pallidipes* also.

From Katombe to Kongolo.

Park country, as from Katombe to Kabala, but not continuously typical park, which disappears a little before Kongolo and especially between the villages Kalengo and Masembe. *G. morsitans* occurs, although in small numbers, as far as Kalenge (associated with *brevipalpis* and *pallidipes*).

From Kongolo to Kabinda by way of Kifukutu (Lomami).

I would begin by explaining that from just before the source of the river Kafuy, that is, from a little way before the Lualaba-Lomami watershed, the grassy savannah begins and stretches as far as the Lomami and beyond, on the west. I need scarcely say that here not a single *morsitans* exists.

But the case is more complicated with regard to the first part of the route in question, from the Lualaba up to near the source of the Kafuy. As regards vegetation, this stretch is a succession of patches of park, wooded savannah, grassy savannah and even strips of forest. It is probably the northern or north-western limit of the great Katanga park. *G. morsitans* is here at first glance as inconsistent and capricious as the vegetation, but more attentive observation shows a perfect consistency in the uneven distribution of the fly, which is found only in those spots where the vegetation is park-like. This then is probably the northernmost extension, the outermost limit of that great area over which *G. morsitans* is distributed. And I would add that, even where it exists, *morsitans* is very scarce in this region. Indeed, it must be sought for so carefully, that for practical purposes it perhaps need not be taken into account. Places are marked on the map where I have found *morsitans*. The last place, the most western point, is the village Katongwe, near to the river Kafuy.

Besides *morsitans*, and in much larger numbers than that species, I also found in this part of the route *brevipalpis*, *pallidipes* and *palpalis*, the two first occurring in the same spots as *morsitans*.

From Lobunda to Kabinda by way of Lupongo (Lomami).

I have already explained that in going from Katombe to Kongolo, that is from the south to the north, it is noticeable that the park ends a little before Kongolo-Lubunda, where Braine l'Alleud (or the Hospital of Km. 300) is placed a few dozen kilometres to the north-west of Kongolo, and at some kilometres south of 5° S. Lat. on the Kindu-Kongolo railway (second section). I have not been able to examine the Kongolo-Lubunda route from the point of view of tsetse, having made this journey by train. But, judging from the vegetation, I do not think I could be mistaken in predicting, *a priori*, the existence in this region of *brevipalpis* and *pallidipes*, and the absence on the other hand of *morsitans*. This vegetation is, in fact, transitory: a mixture of thin park, of more or less wooded savannah and a little forest—the wooded savannah predominating. Some kilometres before Lubunda the trees suddenly disappear almost entirely, and give place to a grassy and undulating landscape. This is the great grassy savannah which separates the park of Katanga from the great equatorial forest.

From Lubunda to Kabinda there is, so to speak, a single stretch of grassy savannah interspersed with wooded strips along the streams and rivers. I am not taking into consideration the bushes and shrubs scattered about, nor the isolated spots that are fairly well wooded, particularly in the proximity of the rivers.

As for tsetse, I found in several spots *brevipalpis*, *pallidipes* and *palpalis*, but nowhere did I find a single *morsitans*.

Referring to the map, it is seen that the Lubunda-Lupongo route is more or less parallel to that from Kongolo to Kifukutu, but at some dozens of kilometres more north. I found *morsitans* on the Kongolo-Kifukutu route, but not a single one on the Lubunda-Lupongo route. It is therefore here, between these two routes, that the northern limit of *morsitans* in northern Katanga must be placed, between the Lualaba and the Lomami. Generally speaking this limit coincides with 5°30' S. Lat.

It must be understood that the limit of *morsitans* is not a precise line; it is neither sharply defined nor permanent. Apart from the fact that close to the edge of the great park *morsitans* is sometimes so rare that the few existing specimens may escape observation (which, from a practical point of view, is of no importance), the boundaries of its distribution are also subject to seasonal variations; bush fires particularly modify its range by producing a real temporary migration of *morsitans*. Here is a striking example. The usual limit of this fly occurs some kilometres east of the station of Katombe. I passed several weeks in this station during the rainy season and never saw a single *morsitans*. Moreover, the real park does not commence before some kilometres' distance from Katombe, and the station itself is surrounded by a large tract of forest. But towards the middle of the dry season, after the general burning of the bush, *morsitans* appeared in the station in fairly large numbers, and could even be found in the houses. At the same season it was also seen 2 or 3 kilometres west of Katombe. It is readily understood that such a great calamity as an

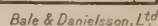
uncontrollable fire produces among these flies a general rush for safety, and a temporary disturbance of their habits. For the same reason a terrified antelope will sometimes arrive in the midst of a large station in broad daylight. But the danger passed, everything returns to its usual order, and some weeks after, in order to find *morsitans* in the vicinity of Katombe, it had to be sought for in its habitual residence, some kilometres east of the station.

Summary.

The hypothesis which I have previously suggested, that the limit of *morsitans* coincides more or less with that of the park (at least in Katanga), has just been confirmed by several new observations. But sometimes the range of the fly terminates before the disappearance of the park. This double disappearance is *generally* gradual.

Between 9° and 5° S. Lat. the western limits of the park and of *G. morsitans* coincide roughly with the Lualaba-Lomami watershed, but most frequently they disappear a little to the east of this line, that is to say, they do not quite reach the Lomami basin.

In this region, between the Lualaba and the Lomami, the park and *morsitans* gradually disappear in the neighbourhood of 5°30' S. Lat., that is, a little south of Kongolo.



PRELIMINARY NOTE ON THE TSETSE-FLIES OF THE KABALO-ALBERTVILLE (LUALABA-TANGANYIKA) RAILWAY.

By Dr. SCHWETZ.

(MAP II.)

The Kabala-Albertville Railway is an important section of that great river and railroad route by which one can now cross the whole of equatorial Africa from Banana to Daressalaam, from the Atlantic Ocean to the Indian Ocean, without having to walk a single step. It is therefore a railway with a great future, which deserves to be studied from all points of view, and particularly with regard to the distribution of tsetse-flies, as the region traversed by this railway was ravaged a few years ago by sleeping sickness and the railway is probably destined in part for the transport of cattle.

A third of this railway, or rather of its route before construction, had already been investigated by me from the point of view of tsetse exactly five years ago, in October 1911,* but besides the fact that at that time I had studied only a part of the route, our general knowledge, and mine in particular, of the classification and habits of *Glossina* have since then considerably increased. I had, therefore, not only to complete my former observations, but to recommence them. But although having desired to do this for some time, while I had been in the neighbourhood of Lualaba, it is only recently, at the beginning of 1916, that I have been able to recommence, but unfortunately not to finish, my investigations. I have only been able to give 14 days to my journey of investigation between Kabalo and Albertville, and during that short journey I was convinced that I ought to give six weeks or two months if I were to study the question thoroughly.

I hope soon to have the necessary time to proceed to a more thorough study of the position, but as one is never sure of being able to carry out a plan, I think it well to record at once the result of some preliminary observations.

To make my record systematic, I proceeded in the following manner. I first journeyed uninterruptedly by train from Kabalo to Albertville (a day and a half), in order to gain a general idea of the district. During the return journey I stopped for 24 hours in nine different spots. In three of these districts I stayed 48 hours. Finally I traversed about 40 kilometres in lorries. My description follows the same course. I will first describe what I saw in general and then what I found in the various districts. The presence of *Glossina* depends almost entirely, in my opinion, on the character of the vegetation. I will therefore begin with a description of this, which I consider a most important point.

The Country bordering on the Kabalo-Albertville Railway.

The Lualaba-Tanganyika Railway measures exactly 273 kilometres, and a straight line drawn between the two termini would measure approximately 250 kilometres.

* Les Glossines et la maladie du sommeil dans la vallée de la Lukuga.—*Revue zoologique africaine*, Bruxelles, 1912, et *Archiv für Schiffs-und Tropen-Hygiene*, Leipzig, 1913, (C394)

From the point of view of the landscape in general, and vegetation in particular, this distance is divisible into three sections :—(1) from Lualaba to the Luizi River, 63 kilometres ; (2) from the Luizi River to the Niemba River, 174 km. ; (3) from the Niemba River to the Lake or Valley of Lukaga, 273 km.

First Section.

The route of this section forms almost a straight line, and the ground is flat or slightly undulating. There is no stream in the neighbourhood of the railway. As to the vegetation, the country is wooded a few kilometres from Lualaba, but becomes gradually transformed into open, slightly wooded, meadow land a little before the Luizi. A great thinning of the trees is noticeable between kilometres 25 and 28 and again at kilometres 31 and 37. In certain places alongside the railway the trees are less abundant ; probably this is an artificial clearing, the wood having been cut for fuel for the locomotives, steamers from Lualaba, etc. This clearing, which is frequently noticeable along the route, and which will doubtless become more accentuated, ought certainly to have a great influence on the distribution of *Glossina*.

The river Luizi flowing from Lukaga is nearly 40 metres wide where the river crosses it. There are no fordable places at the end of the dry season. The river flows through a wide grassy valley, which is completely inundated in the rainy season. The banks of the Luizi are entirely grass-covered, close beside the bridge as well as for a certain distance up and down the river, but trees are visible at about one kilometre down the river.

Second Section.

While the first section is uniform and easily described in a few words, so far as vegetation is concerned, the second section presents different aspects in various parts.

Beyond the grassy valley and low-lying marshes of the Luizi the ground rises, and after one or two kilometres of wooded plain again becomes park-like. But at km. 93, that is after 30 km. of park, comes a low-lying plain about 5 km. long and relatively little wooded, but with many borassus palms. At the beginning of this plain, at km. 93, the Luambashi stream, flowing from the Loyeye, is crossed, the banks being covered with climbing, bushy vegetation, and apart from some small pools of stagnant water, I found it dry (October). After the plain, the vegetation becomes patchy and alternates between park and forest. Sometimes there is, after several kilometres of park, a stretch of forest, and sometimes small patches of forest are interspersed with patches of park. Sometimes the vegetation is undefinable, being less thick than forest and thicker than typical park land. Apart from numerous stretches of one or two km. of true forest, the road traverses a stretch of tropical forest about 7 km. in extent, notably between km. 131 and 138. Referring to the map, it is evident that from just beyond the Luizi until just before the Niemba, and especially up to km. 166, the railway follows closely the river Loyeye (a tributary of the Luizi). Thus the river is a considerable distance from the railway (never less than 4 or 5 km.), flowing in a wide valley, while the railway follows a ridge bordering this valley. Little streams flow down from this ridge, others follow at the base for a certain distance, and nearly all these streams and their sources are surrounded by forest. It is evident, then, that when the railway follows beside a stream or its source it crosses or follows a band

of forest. Here and there the immediate vicinity of the railway seems very little wooded, although in reality the route is surrounded by forest; this is caused by the artificial clearing of the route referred to above.

The second section, to summarise, shows a vegetation which is transitory between park and forest, or an alternation of these two types of vegetation.

Third Section.

This is the most picturesque and the most interesting part of all the journey. After passing the River Niemba close to its mouth, which is about 15 metres wide with open banks, the railway follows the Lukuga until it joins Tanganyika. The distance between the river and the railway is variable—generally 50 to 100 metres, sometimes even more, but very often much less—and in many places the railway follows the river bank at only a few metres distance. The streams (and consequently the bridges) are very numerous in this part. It is this section (the valley of the Lukuga) which I examined five years ago. With regard to vegetation, the valley of the Lukuga and its sides are park-like. The river itself is bordered with papyrus, trees, shrubs and creepers. According as one or other of these types of plants predominates, the river-side vegetation becomes more or less thick, but the banks are almost always well shaded, although they could hardly be described as wooded. It is especially in this third section that artificial clearing is most noticeable. In several places, especially in the proximity of the habitations of European engineers, there are no trees left between the railway and the river, nor for a certain distance on the other side of the railway.

The Species of Tsetse-flies.

In order to simplify the description, I shall deal separately with the *Glossina* of each section, beginning with the third and finishing with the second.

Third Section.

During my first journey in this region, in 1911, I found *G. palpalis* and *G. morsitans*, the first along the Lukuga and the second throughout the valley. In the vicinity of the village Kibogolo, corresponding to km. 232 (but on the opposite side of the river), I also found *G. brevipalpis* (which I, in common with others, identified at that time as *G. fusca*). Since then, with a better understanding of the habits of *G. brevipalpis*, I suspected that this species also would be found more or less throughout the valley, and in fact I did find *G. brevipalpis* on the railway itself in three places which I visited in the evening, especially at km. 259, 219, and near to the Niemba. I was surprised at the rarity of *G. morsitans*. I saw none in the train and I found very few specimens in the two places where I stopped, in spite of the fact that that species was present there in great numbers in 1911. What has become of it? Well, I think that the partial diminution of *G. morsitans* is a consequence of the progressive clearing of the railway. I am convinced that beyond Lukuga, on the right of the valley, where conditions have not changed, *G. morsitans* is as numerous as ever. But conviction is not sufficient for affirmation; to make certain it must be proved on the spot that facts correspond to supposition. I hope soon to be able to elucidate this question. It is also probable that *G. pallidipes* exists in the valley.

With regard to *G. palpalis*, although it occurs almost throughout Lukuga, I saw but one specimen, and that in the railway carriage, in my double journey (going and returning).

In brief, I would say that from the Niemba to Tanganyika almost all along the railroad three species of *Glossina* exist: *palpalis*, *morsitans* and *brevipalpis*. All three species are so rare close to the railway itself that they need scarcely be reckoned with as regards passengers, either human or animal. It is quite different for those, either Europeans or natives, who have to live close to the railway and to the river and who are constantly moving about in the vicinity.

First Section.

There is no need to be a specialist, or particularly observant to find tsetse between Kabalo and Luizi. Some kilometres before Kabalo these flies begin to come into the compartment when the windows are open. When closed, the flies can be seen trying to enter, stuck, as it were, to the windows. Coming in the train from the opposite side, from Tanganyika, it is at some kilometres distance after passing the Luizi that the same phenomena are observed. Not only are the flies constantly seen, but they are also felt. I do not think that there are many passengers who have travelled over this region without being bitten by a tsetse. It is common knowledge here that this fly is *G. morsitans*. But it is not common knowledge that, besides *G. morsitans*, two other species exist here, namely *pallidipes* and *brevipalpis*. *G. pallidipes* is common enough here and exists in this section all along the railway, although in much smaller numbers than *G. morsitans*. I have seen *pallidipes* at km. 25 and 16 (where I stopped) and particularly between km. 25 and Kabalo, during a ride in lorries. *G. brevipalpis* on the other hand is very rare here. I have seen only a very few specimens in the vicinity of km. 15. This is the more surprising as at the same latitude, west of the Lualaba, *brevipalpis* is very common.

Second Section.

The study of the *Glossina* of the second section is as complicated and difficult as that of the first section is simple and easy. Practically speaking, from the point of view of passengers, there are not any tsetse in this section.

In coming from Lualaba, there may be one or two *morsitans* still in the train after the Luizi, just as in coming from Tanganyika, or from the Lukuga, there may still be in the train a *morsitans* or a *palpalis* long after the Niemba is passed; but these are imported flies, at any rate so far as *morsitans* is concerned, for this species does not occur along the second section of railroad, or exists in such small numbers that I have not found it. And yet, if the second section is much poorer in *Glossina* in general, as regards quantities, than the other sections, it is richer than the other sections in the number of species.

While the first and third sections possess a vegetation more or less uniform, and the *Glossina* found there are more or less regularly distributed, it is different in the second section, where the vegetation is polymorphous and transitory, and where the *Glossina* are consequently localised. (I cannot of course repeat in each of my papers the relations between the vegetation and the different species of *Glossina*. These relations have been explained in several articles that I have published in various

scientific journals). In other words, if, after having examined several spots of the first or third sections, and having found one or other species of *Glossina* there, one may conclude with almost certainty that the same species are to be found throughout each section, it is different in the second section, where various species may be found at a few kilometres distance from each other. So that in making an approximately accurate map (none could be absolutely correct) of the distribution of *Glossina* in the second section, the ground must be examined almost step by step.

The districts on the second section where I have spent a day or two seeking *Glossina* are as follows :—

(1). Km. 169 (Hospital). A fine plateau, about 3 km. (in a straight line) from the Niemba and 1·500 km. from the Lukuga. Vegetation transitorily wooded (especially artificially), but park-like around the Hospital. Apart from the *palpalis* found at the Lukuga and the Niemba, no *Glossina* were seen about the Hospital. Above all, the absence of *brevipalpis* astonished me. The Director of the Hospital informed me that this species existed about the Hospital, but in very small numbers. During my stay at km. 169, it first rained and then turned cold.

(2). Km. 123. The railway here passes beside a deep, marshy valley, the source of a stream which is a tributary of the Loyeye. The swamp is covered with a very thick growth of trees forming quite a forest. The rest of the surrounding district is covered with transitory vegetation (forest-park, etc.). *G. brevipalpis* captured in the evening, on the railway; no other species found.

(3). Km. 105. About 2 km. from the source of a stream, tributary of the Loyeye. The source is surrounded by true forest; about the railway in this district the vegetation is mixed and transitory (forest-park). On the railway, close to the plate-layer's house and between the railway and the source, I caught several *pallidipes*, numerous *brevipalpis*, two *palpalis* (probably coming from the source), and two *fusca*.

(4). Km. 93. Stream Luambashi. The country is here flat and relatively little wooded; Borassus palms are present. I captured several *palpalis* at the stream close beside the railroad; no other species was found.

The results show that in none of these four places have I seen *morsitans*, which hardly surprises me. But what does astonish me is the absence of *morsitans* between Luizi and km. 93, the vegetation along all this distance being continuously park-like. It is true that I did not stop here, and it is therefore possible that *morsitans* may occur here, although certainly rare. But it is also possible that the park only exists in the vicinity of the railway, and that further off at one or both sides the vegetation is different. All this must be examined again.

Another district we investigated carefully is the route between km. 131 and 138. This forms a continuous strip of forest and it is probable that *fusca*, among other species, will be found there. With regard to the Luizi, the banks of which are completely cleared of trees, both up and down the railway, I saw no *palpalis* during my two journeys and short stoppages. However, I was assured that *palpalis* is sometimes seen close to the bridge over the Luizi. This is possible, especially as the banks of the Luizi about 1 km. down the river become wooded, and it is probably from there that this fly comes.

During this journey I recorded for the first time a curious fact. The hearing is, as is well known, sometimes a very good means of detecting certain kinds of insects, and particularly flies, without their being seen. A tsetse, a Hymenopteron, an ordinary fly, etc., can be recognised by the sound of their flight. Moreover, one can distinguish by this means different species of Hymenoptera (wasps, bees), different gadflies (*Haematopota*, *Tabanus*), different ordinary flies (house-fly, *Sarcophaga*), and different mosquitos. With regard to *Glossina*, it is easy to distinguish the flight of a large tsetse (*brevipalpis*, *fusca*) from that of a small one (*morsitans*, *palpalis*). Even with certain practice one is able to distinguish the flight of a *fusca* from that of a *brevipalpis*. The sound produced by *brevipalpis* in flying over the ground or over grass by night is so typical that one is scarcely ever deceived. I will not say never, because I have just been deceived. Starting about 12.30 p.m. in search of *Glossina* in the district of km. 123, I soon heard the typical sound of the flight of numerous *brevipalpis*. But on looking carefully on the ground I found quite different flies. I observed the same phenomenon the next day in the district of km. 105. This other fly flew in exactly the same manner and produced the same sound as *brevipalpis*. The confusion occurred particularly because at km. 105 this fly was associated with the real *brevipalpis*. The fly in question is probably a *Choeromyia*, or at least closely allied to the genus *Auchmeromyia*.

Considering this study as a preliminary and incomplete note, I will abstain for the moment from drawing any conclusions, and will limit myself to two considerations: one theoretical and the other practical.

It is a fact that *G. morsitans* exists along the railroad between the Lualaba and the Luizi in great numbers, and between Tanganyika and the Niemba in rather less numbers, but not at all (or hardly at all) between the Luizi and the Niemba. As, in my opinion, it is the difference in the species of vegetation that governs the tsetse question, it is in the vegetation of the three sections that I have sought the explanation of the presence or absence of *morsitans*. I have not mentioned the much-discussed big game, which constitutes, in the opinion of many, the real reason for the presence of *morsitans*, because I do not believe it; and I do not believe it because, as I have already stated at length elsewhere, game exists everywhere in Central Africa, equally where *morsitans* occurs and where there are neither *morsitans* nor other tsetse.

However, in science, we have no preconceived ideas. Therefore, *auditur et altera pars*. And this is the explanation of the distribution of *G. morsitans* along the railway of Kabalo-Albertville given to me by a colleague who knows the region well.

"Many *morsitans* exist between the Lualaba and the Luizi, because game is very abundant there; there are no *morsitans* between the Luizi and the Niemba, because in this section game is rare."

This explanation has the great advantage of being short and clear, but it is too theoretical and categorical and not sufficiently accurate. That game is more abundant in the first section than in the second, I quite admit, but game exists also throughout the second section. Moreover, if game is rarer here, it is because the trees grow here more thickly.



And how can we explain by the game theory the diminution in *morsitans* along the third section, in the valley of the Lukuga ? At first glance the explanation seems very simple and easy. "The construction and exploitation of the railway (and the passage of troops) have produced a great diminution in the game, and that is the cause of the diminution of *morsitans*." Very well. But on the other hand there exists now a continual coming and going of men along the railway (instead of very few natives as in former times), and are not men from the point of view of *morsitans* game, like any other animals ? Is not the diminution of *morsitans* rather due to the artificial clearing of the banks of the railway and of the thinning of trees in its vicinity ? The clearing along the railway by force of circumstances will continue, and in the near or distant future we may expect a large track denuded on each side of the route, which will be followed by a notable diminution in tsetse, and even eventually by their more or less complete disappearance, according to whether the denuded track is wide or narrow. However, this is only theory. In reality there will probably be several series of artificial clearings, that is to say bare tracks alternating with wooded stretches, which obviously will not cause the disappearance of *Glossina* throughout the length of the railway. It rests, therefore, with the Directors of the Railway not to lose sight of the question of the tsetse and to organise their clearings accordingly.

Kabinda, December, 1916.

ON A BRACONID PARASITE OF *GLOSSINA*.

By ROWLAND E. TURNER.

***Coelalysia glossinophaga*, sp. nov.**

♀ Testacea; capite nigro; mandibulis fusco-ferrugineis; scapo fusco; flagello nigro, articulis 40, articulis 15—28 albis; tarsis articulo apicali fusco; terebra, abdomine paullo longiore, nigra; alis hyalinis, iridescentibus, venis nigris.

♂. Feminae similis; flagello omnino nigro; segmentis abdominalibus tertio apice, quarto et sequentibus nigris.

Long. ♀♂, 5 mm., terebrae long. 2 mm.

♀. Fourth joint of the antennae fully half as long again as the third; all the joints hairy. Clypeus subtriangular, narrowly rounded at the apex; mandibles very broad, with two apical teeth, the inner one acute, the outer one broad and blunt. Smooth and shining; the face below the antennae very minutely punctured; parapsidal furrows deep, finely crenulated, nearly reaching the posterior margin of the mesonotum; scutellum with a deep depression at the base which extends almost to the middle, the depression very broad and divided in the middle by a high and very narrow carina; dorsal surface of the median segment only a little longer than the postscutellum, very short, distinctly margined posteriorly, finely punctured, with a median longitudinal carina; the surface of the posterior truncation with a median area which is finely longitudinally striated and enclosed by carinae converging towards the apex. First dorsal segment irregularly longitudinally rugulose, distinctly longer than the apical breadth, much broadened from the base, with a blunt tubercle on each side before the middle. Sheaths of the ovipositor with sparse long hairs; the legs also thinly clothed with hairs. Second abscissa of the radius more than half as long again as the second transverse cubital nervure; the second cubital cell distinctly pentagonal, the recurrent nervure received close to the base of the cell.

♂. As in the female, except in the colour differences of the antennae and abdomen. The antennae are broken at the extreme apex in the only available specimen.

GOLD COAST: Northern Territories (*J. J. Simpson*).

Bred from pupae of *Glossina*.

Species of this genus are described by Szépligeti in the genus *Idiasta*, and by Cameron and Enderlein in the genus *Alysia*. From the former this seems to be separated by the pentagonal second cubital cell, from the latter by the proportions of the third and fourth joints of the antennae.

The species included in the genus seem to be: (1) *Coelalysia lutea*, Cam., 1911; (2) *Idiasta nigriceps*, Szép., 1911; (3) *Idiasta bicolor*, Szép., 1911; (4) *Alysia camerunensis*, Enderl., 1912; (5) *Alysia goniarcha*, Cam., 1912; (6) *Alysia maculiceps*, Cam., 1912.

All these Ethiopian species are very closely allied, but differ in details of colour and the number of joints of the antennae of the female, and in the colour of the head and abdomen of the male. I have seen only the male of *bicolor* and the male of *lutea*.

CHALCIDOIDEA BRED FROM *GLOSSINA* IN THE NORTHERN TERRITORIES, GOLD COAST.

By JAMES WATERSTON, B.D., B.Sc., Lieut. R.A.M.C.

The material on which the following report is based was received by the Imperial Bureau of Entomology some months ago, but without any note as to the host attachment of the examples forwarded or any other indication of their special importance. For this reason the two species of Chalcids recorded below remained unworked for some time. A more recent letter from Dr. J. J. Simpson disclosed the interesting fact that both had been bred from puparia of *Glossina*; and although I am unable at present to deal fully with them, it seems advisable to publish some notes and a preliminary description of one species which seems certainly new.

***Dirhinus inflexus*, sp. nov.**

♀. Head, thorax and abdomen black; the flattened setae on head (superiorly) and thoracic notum yellow, but whitish on genae. Fore wings brown-tinted, veins a little darker. Fore and mid coxae and hind legs (except the tarsi) black; fore



Fig. 1. Lateral view of the heads of *Dirhinus ehrhorni*,
Silv. (left) and *D. inflexus*, Waterst. (right).

and mid legs otherwise brown; hind tarsi the same but paler. Tip of ovipositor sheath brown. Antennae brown, more or less infuscated, especially on the funicle, but paler at the tip.

Length, $3\frac{1}{2}$ mm; alar expanse, $5\frac{1}{2}$ mm.

Type ♀ in the British Museum.

GOLD COAST: Larabanga, N. Territories, 1-6.vii.1916 (*Dr. J. J. Simpson*).

D. inflexus is closely related to *D. giffardi*, Silv. (Boll. Lab. Zool. Portici, viii, p. 128, figs. liii-lvi, 28th Nov., 1913), and *D. ehrhorni*, Silv. (*ib.*, p. 132, figs. lvii-lviii), both of which were described from Southern Nigeria, where they attack fruit-flies of the genus *Ceratitis*. In *D. giffardi* the wings are nearly hyaline, the antennae

much redder and darker apically, while in profile the frons from the insertion of the antennae to the extremity of the large process is straight. There are other differences in the propodeal sculpture. From *D. ehrhorni* the new species differs in the colour of the antennae and in the profile—particularly in the size of the eye (see fig. 1).

For these drawings I desire to express my cordial thanks to Prof. F. Silvestri, who has obligingly compared the types of *inflexus* and *ehrhorni* with one another, finding, as he notes, that in the *Glossina* parasite the frontal processes are longer and the sculpture of the dorsum coarser.

***Chalcis amenocles*, Walker.**

Chalcis amenocles, Walker, List. Hym. Brit. Mus. Chalcid, i, p. 84, 1846 (Sierra Leone).

The following three series were received from the Gold Coast, N. Territories (*Dr. J. J. Simpson*):—(a) 7 ♂♂, 9 ♀♀, without data, 1916; (b) 2 ♀♀, Larabanga, 1–8.vii.1916; (c) 1 ♂, 3 ♀♀, Yapi, vi.1916. There is also a single ♂ sent without data by Dr. Simpson amongst a miscellaneous lot of captured insects. The ♀♀ range in size from about 4 mm. long, with an expanse of $5\frac{1}{2}$ mm., to $5\frac{1}{2}$ mm. long, with an expanse of $8\frac{1}{2}$ mm. The ♂♂ are $4\frac{1}{4}$ – $4\frac{1}{2}$ mm. long, with an expanse of $6\frac{1}{2}$ mm. or over.

I have placed the above examples of *Chalcis* together and under the name *amenocles* with some hesitation. In the *amenocles* group several more or less distinct forms have already been described from South Africa, e.g., *capensis*, Cam. (1905), *spilopus*, Cam. (1905), *transvaalensis*, Cam. (1911), and *varipes*, Wlk. (1871). These seem to me to differ very little, except in size, from one another, but it has not been possible to make a critical examination of the mouth-parts in each case. Until this has been done the status of these forms must remain undecided.

THE STATUS OF INTRODUCED COCCIDS IN SOUTH AFRICA IN 1917.

By CHAS. K. BRAIN and ALBERT E. KELLY,

Division of Entomology, Pretoria, South Africa.

It will probably be of interest to workers on Coccids in other parts of the world to know which species have been introduced into South Africa and to what extent they have become established. Moreover, since so many of these are constantly found during the inspection of our nurseries, etc., it seems desirable to place on record their known distribution (August, 1917) for future reference. Fifty-five are included in this list, which is considered to be approximately complete. Others, such as *Lecanium bituberculatum*, Targ., *L. corni*, Bouché, *Pulvinaria betulae* (L), Sign., *Diaspis rosae* (Bouché), *Aspidiotus piri*, Licht., and *A. ostreaeformis*, Curt., have been stopped at the ports of entry, but since these species are not established in the country they are not included.

A large number of the records are compiled from the nursery inspection reports of the junior writer. Whilst these are complete for localities in which registered nurseries exist, there may be other parts of the Union where the species is present but from whence no report has been obtained.

Subfamily MONOPHEBINAE.

1. *Icerya purchasi*, Mask.

Generally distributed throughout the Union but satisfactorily controlled by *Vedalia* (*Novius cardinalis*). This scale often breeds up abundantly on the Witwatersrand until summer is advanced, when *Vedalia* again gains the upper hand for a month or two.

2. *Icerya seychellarum*, Westw.

Durban (Johannesburg, ex Durban).

Subfamily ORTHEZIINAE.

3. *Orthezia insignis*, Dougl.

Cape Peninsula, Port Elizabeth, East London and Natal Coast. Sporadic in Natal midlands (2,000–3,000 ft.).

Subfamily DACTYLOPIINAE.

4. *Pseudococcus adonidum* (Linn.), Westw.

Cape Town, Port Elizabeth, Durban, Pietermaritzburg, Pretoria and Johannesburg. Chiefly a pot-plant pest.

5. *Pseudococcus aurilanus* (Mask.).

Cape Town, Graaff Reinet, Durban, Pietermaritzburg, Richmond, Johannesburg and Pretoria.

6. *Pseudococcus bromeliae* (Bouché).

Eastern Cape Province and Natal Coast.

7. *Pseudococcus citri*, Risso.

Although common in most parts of the country the habit of this species is somewhat puzzling. It is prevalent in the Cape Peninsula, but generally confined to nurseries, where it would appear to be Dr. Marchal's variety, *Ps. citri* var. *coleorum*, as it is chiefly bad on coleus. In the same locality it is very seldom found on citrus, being replaced by *Ps. fragilis*, Brain; the most common species in vineyards and gardens is *Ps. capensis*, Brain. In Natal similar conditions obtain, but the citrus species here is *Ps. filamentosus*, Ckll., while the most common species in gardens in Durban is *Ps. virgatus*, Ckll. In Pretoria *Ps. citri* is occasionally extremely abundant on oranges, but from the majority of the citrus orchards, such as those of Rustenburg, etc., the species is apparently absent. The most common species in gardens in Pretoria is *Ps. burnerae*, Brain.

8. *Pseudococcus filamentosus*, Ckll.

Bathurst, Richmond, Pietermaritzburg (citrus), Pretoria (grevillea).

9. *Pseudococcus nipae*, Mask.

Cape Town, Graaff Reinet, Port Elizabeth, Uitenhage, Durban, Pietermaritzburg, Johannesburg and Pretoria. Found only on palms in greenhouses, except at Durban, where it is occasionally found out of doors.

10. *Pseudococcus sacchari*, Ckll.

Zululand, Natal Coast, and Tzaneen (Transvaal).

11. *Pseudococcus virgatus*, Ckll.

Durban, Pietermaritzburg and Pretoria (ex Durban).

12. *Tylococcus insolitus* (Green).

East London, Kingwilliamstown, and Pietermaritzburg.

13. *Eriococcus araucariae*, Mask.

Common in the Cape and Natal and occasionally found in Johannesburg and Pretoria.

Subfamily ASTEROLECANIINAE.

14. *Asterolecanium bambusae*, Bdv.

Natal coast and midlands.

15. *Asterolecanium variolosum* (Ratz.).

Cape Peninsula, Elsenburg, Grabouw, Paarl, Simondium, Irene, Johannesburg, Krugersdorp, Newclare and Canada Junction.

16. *Cerococcus ornatus*, Green.

Found on one occasion only on stems of *Dovyalis caffra*, Harv., and *Calcdendron capense*, Thunb., at Pietermaritzburg.

Subfamily COCCINAE.

17. *Coccus cacti*, Goeze.

Botanic Gardens, Cape Town, where it was introduced many years ago.

18. *Coccus confusus capensis*, Green.

May usually be found wherever *Opuntia monacantha* is abundant, e.g., in the Cape Peninsula, Albany and surrounding districts, Natal, and occasionally in the Orange Free State.

19. *Coccus indicus*, Green.

Introduced by the Queensland Prickly Pear Commission in 1913 to destroy *Opuntia monacantha*. It is now well established in the Cape Peninsula, Komgha, Natal and Pretoria, and was recently received from Mtunzini in Zululand.

Subfamily LECANIINAE.

20. *Lecanium hesperidum*, Linn.

Widely distributed and common.

21. *Lecanium elongatum*, Sign.

Johannesburg and Pretoria.

22. *Saissetia hemisphaerica* (Targ.).

Cape Town, Grahamstown, Durban, Pietermaritzburg, Pretoria and Johannesburg (pot plants).

23. *Saissetia nigra*, Nietn. (*S. nigrella*, King).

Bayville C.P., and Natal coast (on *Ficus* spp. only).

24. *Saissetia oleae*, Bern.

Cape Peninsula, Ceres, Port Elizabeth, Queenstown, Stellenbosch, Uitenhage, Fort Beaufort, Durban, Pietermaritzburg and Pretoria.

25. *Protopulvinaria pyriformis*, Ckll.

Durban (Pietermaritzburg, ex Durban).

Subfamily DIASPINAE.

26. *Aspidiotus destructor*, Sign.

Durban and Inchanga (uncommon).

27. *Aspidiotus fimbriatus* var. *capensis*, Newst.

Port Elizabeth (on Cycads only).

28. *Aspidiotus* (*Diaspidiotus*) *forbesi*, Johns.

Cradock, Pietermaritzburg, Potchefstroom and Bethlehem.

29. *Aspidiotus hederæ* (Vall.), Sign.

Widely distributed throughout the Union, and common.

30. *Aspidiotus* (*Hemiberlesea*) *latanize*, Sign.

Generally distributed.

31. *Aspidiotus* (*Hemiberlesea*) *rapax*, Comst.

Johannesburg, Louis Trichardt and Pretoria.

32. *Aspidiotus* (*Diaspidiotus*) *perniciosus*, Comst.

In most centres an attempt has been made to eradicate this insect as soon as discovered. It has been reported from:—Estcourt, Frere, Hilton Road, Ladysmith, Moorleigh, Newcastle, Pietermaritzburg, Utrecht, Vryheid, Weenen, Winterton, Dundee and Richmond, in Natal; Amersfoort, Benoni, Bethal, Boksburg, Boskop, Bronkhorstspuit, Cullinan, Heidelberg, Johannesburg, Middelburg, Nylstroom, Pretoria, Rayton, Scheerpoort, Standerton and Witbank, in the Transvaal; Kroonstad and Viljoen's Drift, in the Orange Free State.

33. *Aspidiotus transparents*, Green.

Natal coast.

34. *Aspidiotus (Selenaspidus) articulatus*, Morgan.

Durban and Pietermaritzburg. This is an uncommon scale. Our commonest species of *Selenaspidus* is *silvaticus*, Ldgr.

35. *Chrysomphalus aurantii*, Mask.

Widely distributed throughout the Union.

36. *Chrysomphalus dictyospermi*, Morgan.

Cape Town, East London, Kimberley, Kingwilliamstown, Durban, Pietermaritzburg, Barberton, Johannesburg, Nelspruit, and Pretoria. This species is common only in greenhouses, and whilst it has been found on rose and peach, it has not yet been recorded on citrus in this country.

37. *Chrysomphalus ficus*, Ashmead.

Common in orchards on the Natal Coast and in a few localities in the Transvaal, such as Warmbaths, Rustenburg and Nelspruit. A greenhouse pest along the Cape and Natal coast, and also at Queenstown, Pietermaritzburg, Johannesburg and Pretoria.

38. *Chrysomphalus rossi*, Mask.

Cape Town,* East London, Grahamstown, Queenstown,* Estcourt, Dundee, Durban, Pietermaritzburg, Johannesburg, Pretoria, Krugersdorp, Pietersburg, Bloemfontein.

38a. *Chrysomphalus rossi* var. *greeni*, nov.

This variety has the brown scale as described and figured by Green in "The Coccidae of Ceylon." East London and Durban on native trees (uncommon).

39. *Morganella maskelli* (Ckll.).

Established in Durban on a number of different host-plants; reported from Pietermaritzburg; on citrus at Hillary.

40. *Diaspis boisduvali*, Sign.

Durban, Pietermaritzburg and Pretoria (uncommon).

41. *Diaspis bromeliae* (Kern.).

Natal coast, Kingwilliamstown and Pretoria. An uncommon scale, chiefly in greenhouses.

42. *Diaspis echinocacti* (Bouché).

Graaff Reinet and Pearston, C.P., and other places in the Karroo.

43. *Diaspis (Aulacaspis) pentagona*, Targ.

Common in the Western Province of the Cape and often found in most of the larger towns elsewhere in the Union.

44. *Pseudaonidia trilobitiformis*, Green.

Hillary (Durban) on Litchi (probably ex Mauritius).

* Reported, but not well established.

45. *Parlatoria pergandei*, Comst.

Cape Town, Grahamstown, Port Elizabeth, Durban, Johannesburg and Pretoria (in greenhouses).

46. *Parlatoria proteus*, Curt.

Durban (in greenhouses, uncommon).

47. *Parlatoria zizyphi*, Lucas.

In several orchards near Durban, but not prevalent.

48. *Chionaspis simplex*, Green, var.

Durban (on bamboo).

49. *Pinnaspis aspidistrae*, Sign.

Common in greenhouses.

50. *Fiorinia floriniae*, Targ.

Cape Town, Graaff Reinet, Grahamstown, Port Elizabeth, Uitenhage, Durban, Hillary, Inchanga, Johannesburg (ex coast). In greenhouses.

51. *Howardia biclavis*, Comst.

Durban.

52. *Howardia moorsi*, Doane & Ferris.

Durban Botanic Gardens.

53. *Lepidosaphes pinniformis*, Bouché.

Cape Peninsula, Port Elizabeth, Uitenhage, Stellenbosch, Somerset West, Bathurst, East London District, Natal Coast, Greytown, Piet Retief, Pietermaritzburg, Barberton, Nelspruit (in citrus orchards). Capetown, Durban, Pietermaritzburg, Uitenhage and Johannesburg (in greenhouses, chiefly on croton and Murraya).

54. *Lepidosaphes gloveri*, Packard.

Port St. Johns, and in four orchards in the Cape Peninsula (Lounsbury, 1896 Report), Stanger and Warmbaths.

55. *Ischnaspis longirostris*, Sign.

East London, Port Elizabeth, Durban, Hillary (Pretoria and Johannesburg, probably ex Durban). Occurs on a number of ornamental plants; at Warmbaths on citrus.

A LIST OF UGANDA COCCIDAE, THEIR FOOD-PLANTS AND NATURAL ENEMIES.

By C. C. GOWDEY, B.Sc., F.Z.S., F.E.S.,
Government Entomologist, Uganda.

In the following list the species marked with an asterisk were described as new from the material collected by the author.

Subfamily MONOPHLEBINAE.

1. *Monophlebus raddoni*, Westw. Food-plant unknown.
2. *Icerya caudatum*, Newst. On crotons.
- *3. *Icerya nigroareolata*, Newst. On coffee and crotons.
4. *Icerya seychellarum*, Westw. On *Monodora myristica*, *Eranthemum bicolor* and mango.
5. *Icerya sulphurea*, Lind. On *Castilloa* rubber and guava.

Subfamily DACTYLOPIINAE.

6. *Asterolecanium bambusae*, Bdv. On bamboo.
7. *Asterolecanium coffeae*, Newst. On coffee.
8. *Pseudococcus bromeliae*, Bouché. On pineapple.
9. *Pseudococcus citri*, Risso. On coffee (leaves, stems and roots), orange, lemon and cacao. The root form is accompanied by an ant, *Acropyga gowdeyi*, Wheeler.*
10. *Pseudococcus virgatus*, Ckll. On coffee.

Subfamily TACHARDIINAE.

11. *Tachardia decorella*, Mask. On *Anona muricata* and guava. Parasitised by *Aenasiella africa*, Gir.* and *Coccophagus nigropleurum*, Gir.*; and preyed on by the caterpillars of *Stathmopoda oestëtis*, Meyr.*

*12. *Tachardia longisetosa*, Newst. On guava, *Ficus thonningii* and *Anona muricata*.

13. *Pulvinaria jacksoni*, Newst. On cotton. Parasitised by *Tetrastichus gowdeyi*, Crawford.*

14. *Pulvinaria psidii*, Mask. On coffee, *Funtumia elastica*, guava, tea, *Alternanthera versicolor* and *Dolichandron platycalyx*.

*15. *Pulvinaria subterranea*, Newst. On chrysanthemum (roots).

16. *Ceroplastes africanus*, Green. On *Cajanus indicus* and *Acacia* sp.

17. *Ceroplastes ceriferus*, And. On coffee, *Antigonon leptopus*, orange, *Funtumia latifolia*, *Canna*, *Hibiscus*, *Agave*, croton, *Anona muricata*, tea and *Ficus thonningii*.

*18. *Ceroplastes coniformis*, Newst. On *Ficus* sp. and *Hura crepitans* (a dark piceous form).

- *19. *Ceroplastes destructor*, Newst. On guava.

- *20. *Ceroplastes ficus*, Newst. On *Ficus thonningii*.
- *21. *Ceroplastes galeatus*, Newst. On coffee and *Ficus thonningii*. Parasitised by *Neomphaloidella ceroplastae*, Gir.,* *Eurytoma galeati*, Gir.,* and *Scutellista cyanea*, Motsh.
- *22. *Ceroplastes quadrilineatus*, Newst. On *Anona muricata* and *Dolichandron platycalyx*.
- *23. *Ceroplastes singularis*, Newst. On guava.
- *24. *Ceroplastes subdenudatus*, Newst. On an undetermined plant.
- *25. *Ceroplastes ugandae*, Newst. On *Anona muricata* and *Acacia* sp.
- *26. *Ceroplastes vinsonioides*, Newst. On *Baikea eminii*, coffee, guava and *Cajanus indicus*.
- *27. *Inglisia castilloae* var. *theobromae*, Newst. On cacao.
- *28. *Inglisia conchiformis*, Newst. On *Hibiscus*, *Anona muricata*, *Acalypha wilkinsonia*, guava and *Harrografia madagascariensis*. Preyed upon by a Lepidopterous larva, *Eublemma scitula*, Ramb.
- *29. *Ceroplastodes gowdeyi*, Newst. On *Ficus thonningii*.
- 30. *Coccus africanus*, Newst. On coffee.
- 31. *Coccus discrepans*, Green. On tea roots.
- 32. *Coccus elongatus*, Sign. On *Albizia* sp. and *Cajanus indicus*.
- 33. *Coccus hesperidum*, L. On orange.
- 34. *Coccus longulus*, Dougl. On *Gliricidia maculata*.
- *35. *Coccus setiger*, Newst. On guava.
- *36. *Coccus signatus*, Newst. On guava.
- *37. *Coccus tenuivalvatus*, Newst. On *Pennisetum purpureum* and *Cymbopogon citratus*.
- 38. *Coccus viridis*, Green. On coffee and guava.
- *39. *Eulecanium filamentosum*, Newst. On an undetermined plant.
- 40. *Eulecanium somereni*, Newst. On mulberry, *Tecoma stans* and *Dolichandron platycalyx*.
- 41. *Saissetia hemisphaerica*, Targ. On ferns and coffee.
- 42. *Saissetia nigra*, Nietn. On coffee, *Ficus* sp. and *Anona muricata*.
- 43. *Saissetia oleae*, Bern. On *Chlorophora excelsa*. Parasitised by *Coccophagus saintebeuvei*, Gir.
- *44. *Saissetia subhemisphaerica*, Newst. On coffee.
- *45. *Stictococcus coccineus*, Newst. On *Acacia* sp., in association with *Ceroplastes subdenudatus*, Newst.
- 46. *Stictococcus diversiseta*, Silv. On *Hibiscus*, *Cajanus indicus*, cacao, *Croton tiglium*, *Anona muricata*, mulberry, *Artocarpus integrifolia* and *Dolichandron platycalyx*. Preyed on by *Eublemma costimacula*, Saalm.
- *47. *Stictococcus formicarius*, Newst. On *Ficus* sp.
- *48. *Stictococcus gowdeyi*, Newst. On coffee and *Harrografia madagascariensis*. Parasitised by *Coccophagus comperei*, Gir.,* and *Epitetrastichus ugandensis*, Gir.*
- *49. *Stictococcus multispinosus*, Newst. On *Dolichandron platycalyx*.

Subfamily DIASPINAE.

- *50. *Chionaspis cassiae*, Newst. On *Cassia floribunda*.
 - *51. *Chionaspis dentilobis*, Newst. On palms and *Sapium mannianum*.
 - *52. *Chionaspis funtumiae*, Newst. On *Funtumia latifolia*.
 - *53. *Chionaspis substriata*, Newst. On palms.
 - 54. *Diaspis boisduvali*, Sign. On *Baikea insignis*.
 - *55. *Diaspis regularis*, Newst. On *Chlorophora excelsa*.
 - 56. *Aulacaspis chionaspis*, Green. On *Sapium mannianum*, *Erythrina excelsa* and *Cassia floribunda*.
 - *57. *Hemichionaspis chionaspiformis*, Newst. On an undetermined plant.
 - 58. *Aspidiotus cyanophylli*, Sign. On guava, palms and bananas.
 - 59. *Aspidiotus cydoniae*, Comst. On guava.
 - 60. *Aspidiotus destructor*, Sign. On bananas, *Pandanus* sp., guava and mango.
- Preyed on by *Epilachna punctipennis*, Muls.
- *61. *Aspidiotus gowdeyi*, Newst. On *Anona muricata*.
 - 62. *Aspidiotus lataniae*, Sign. On palms.
 - 63. *Aspidiotus transparentis*, Green. On tea.
 - *64. *Pseudaonidia baikeae*, Newst. On *Baikea* sp.
 - *65. *Pseudaonidia trilobitiformis*, Green. On oleander and mango.
 - 66. *Selenaspidus articulatus*, Morg. On coffee and *Ficus thonningii*.
 - 67. *Selenaspidus silvaticus*, Lind. On orange.
 - 68. *Chrysomphalus dictyospermi*, Morg. On palms, mango and rose.
 - 69. *Lepidosaphes beckii*, Newm. (= *citricola*, Pack.). On *Citrus* spp.
 - 70. *Lepidosaphes gloveri*, Pack. On *Citrus* spp. and crotons.
 - 71. *Ischnaspis longirostris*, Sign. On palms, bamboo and coffee.
 - 72. *Gymnaspis africana*, Newst. On an undetermined plant.

COLLECTIONS RECEIVED.

The following collections were received by the Imperial Bureau of Entomology between 1st April and 30th June, 1917, and the thanks of the Managing Committee are tendered to the contributors for their kind assistance :—

Dr. W. M. Aders, Economic Biologist to the Zanzibar Government :—33 Diptera from Zanzibar.

Mr. G. E. Bodkin, Government Economic Biologist :—1 Dipteron, 2 Hymenoptera, 5 Coleoptera, 1 species of Coccidae, and 4 other Rhynchota ; from British Guiana.

Capt. G. D. H. Carpenter : 5 Tabanidae, 2 Hymenoptera, 60 Coleoptera, 1 Bug, and 1 Tick ; from German East Africa.

Mr. D'Emmerez de Charmoy, Government Entomologist :—30 Diptera ; from Mauritius.

Division of Entomology, Pretoria : 17 Diptera, 12 Hymenoptera, 36 Coleoptera, and 12 Rhynchota ; from South Africa.

Mr. P. R. Dupont, Curator of the Botanic Station :—1 Hymenopteron, 23 Coleoptera, 15 Coleopterous larvae, 6 packages of Coccidae, 14 other Rhynchota, 4 Orthoptera, 6 Crustacea, and 2 packages of Fungi ; from the Seychelles.

Mr. C. C. Gowdey, Government Entomologist :—1 Bug ; from Uganda.

Prof. Robt. Newstead, F.R.S. :—8 Chalcids ; from Cheshire.

Dr. L. Peringuey, Director of the South African Museum :—56 Chalcids ; from South Africa.

Mr. A. W. Rymer Roberts :—3 Chalcids from Wheat ; from Harpenden, Herts.

Dr. J. J. Simpson :—7 Tabanidae, 120 *Glossina*, 169 other Diptera, 54 Hymenoptera, 32 Coleoptera, and 95 Rhynchota ; from the Gold Coast.

Dr. W. G. Watt, Medical Officer of Health :—274 Mosquito larvae ; from the Gold Coast.

Sir Francis Watts, K.C.M.G., Commissioner of Agriculture for the West Indies :—10 Coleoptera ; from Montserrat.

Wellcome Bureau of Scientific Research :—23 Coleoptera, 5 Lepidoptera, and 2 Rhynchota ; from Venezuela.

Mr. C. B. Williams :—1 Cercopid Bug and about 100 Chalcids ; from Panama.

Dr. J. Y. Wood, W.A.M.S. :—14 *Tabanus*, 18 *Hippocentrum*, and 165 *Glossina* ; from Sierra Leone.

Mr. R. C. Wood :—1 *Tabanus*, about 150 *Simulium*, 141 other Diptera, 12 Siphonaptera, 1 Hymenopteron, 7 Mallophaga, 5 Rhynchota, and 40 Ticks ; from Nyasaland.

BIONOMICS OF TSETSE AND OTHER PARASITOLOGICAL NOTES IN THE GOLD COAST,

By DR. JAMES J. SIMPSON,
Imperial Bureau of Entomology.

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The following report is based on a tour which extended from September 1915 to February 1917, but included in it are also some observations made during a few months residence in 1914.

The area comprised lies partly in the Northern Territories of the Gold Coast, and partly in Togoland (see Map, Bull. Ent. Res., V, p. 32). It extends from 8° N. to 9° 45' N. and from 0° 15' E. to 2° 30' W. My headquarters were at Yapi on the River Volta about 28 miles south-west of Tamale, the capital of the Northern Territories. I have already described in a previous report* the nature of the country and the type of vegetation, so need not repeat them here. I examined the whole of the Volta from Yapi to Yeji by canoe, and then followed a sinuous route on my return journey, keeping as close to the River as possible. The country between Yapi and Daboya, a large town with an important ferry on the Volta, was traversed on several occasions. From Daboya I went to Bole and made my temporary headquarters at Larabanga, the centre of the game and *Glossina submorsitans* area. Here I spent several weeks under canvas in three separate localities in the bush. On my homeward

* Bulletin of Entomological Research, v, pp. 1-36.

journey I visited Yendi, formerly an important German post in Togoland, thence going to Salaga and Kete-Krachi, where I crossed the Volta and proceeded to join the main north road at Atabubu (Tabobo).

This report must be taken in conjunction with my previous report already referred to. It may be advisable to point out here that many of my notes were lost on my homeward voyage, so that certain sections of this account of my work are not so complete as they might otherwise have been. For all practical purposes, however, the actual conclusions arrived at are in accordance with the observations made.

Appended is a table showing the weekly rainfall from 1st June, 1915, to 31st December, 1916. This is the meteorological condition which most greatly affects the seasonal prevalence of tsetse, and also to a great extent puts a limit to bush work. This table should be consulted when reading *inter alia* the section on the "Disparity in the proportion of sexes of *Glossina*."

Month.	1st week.	2nd week.	3rd week.	4th week.	Total for month.
June	1.81	<i>nil</i>	1.83	1.63	5.27
July	1.25	2.03	2.74	<i>nil</i>	6.02
August	<i>nil</i>	0.73	2.21	1.91	4.85
September ..	2.92	2.68	0.05	2.69	8.34
October	1.43	0.34	0.54	0.35	2.66
November ..	<i>nil</i>	<i>nil</i>	<i>nil</i>	<i>nil</i>	<i>nil</i>
December ..	<i>nil</i>	<i>nil</i>	<i>nil</i>	<i>nil</i>	<i>nil</i>
January	<i>nil</i>	<i>nil</i>	<i>nil</i>	<i>nil</i>	<i>nil</i>
February ..	<i>nil</i>	<i>nil</i>	<i>nil</i>	<i>nil</i>	<i>nil</i>
March	0.11	<i>nil</i>	0.83	0.60	1.54
April	1.20	0.85	0.15	2.57	4.77
May	1.83	<i>nil</i>	3.25	0.92	6.00
June	1.61	2.49	0.88	0.35	5.33
July	1.70	2.30	0.47	1.97	5.44
August	1.96	0.97	1.78	8.57	13.28
September ..	1.73	0.74	0.87	1.29	4.63
October	1.48	0.99	0.34	<i>nil</i>	2.71
November ..	<i>nil</i>	<i>nil</i>	1.17	0.70	1.87
December ..	<i>nil</i>	<i>nil</i>	<i>nil</i>	<i>nil</i>	<i>nil</i>

I. Factors Influencing the Distribution and Prevalence of Tsetse.

Dr. Shircore* has drawn attention to what he calls "primary centres" in which he says that *Glossina morsitans* segregate at the period when the conditions of life are unfavourable elsewhere, and from which they disperse when water becomes abundant and the country is covered with grass and the trees with foliage. Several writers on this question in West Africa also refer to "fly-belts." This term has been so loosely used that it is sometimes difficult to establish what is actually meant. If by a "fly-belt" is meant that at certain parts on a road tsetse are more abundant than elsewhere, then such a state of affairs actually exists, but if by the term it is meant to indicate that at certain parts these flies exist in numbers and are not to be found elsewhere in the surrounding country, then the term is misleading and not in accordance with the facts. In all my experience in West Africa I am not conscious of any definite locality, either in the wet or dry season, containing tsetse actually cut off from the surrounding country. To a casual observer this might appear to be so, but if the intermediate country be thoroughly examined, it will be found that tsetse exist linking up these so-called belts, though undoubtedly in smaller numbers.

At the end of the dry season (December, January and February in West Africa), when the forest fires are raging, tsetse (along with game) are undoubtedly driven before them and take refuge in the denser bush unattacked by such fires, but the pupae are seldom damaged and soon repopulate the area burnt, in addition to the adults which return after a very short time. Thus, if an area over which an extensive bush fire has been raging be examined immediately after the fire, no tsetse will be encountered, but if the same area be examined a month later, tsetse will again be found. This is a condition of a purely artificial character, and has no definite relation to the natural segregation of the flies.

In the Northern Territories of the Gold Coast at any rate, it is no doubt the case that there is hardly a square mile where tsetse cannot be captured at some period of the year. This is extremely important in the case of horse transport. In these Territories certain areas are "proclaimed" for horses, but this precaution only leads to a false security. There is no road between any two stations in the Northern Territories free from tsetse, and as it is not the actual number of the flies, but the proportion infected that counts, such a regulation is worse than useless.

Type of Vegetation.—I have already in my reports on the different colonies in West Africa given the types of vegetation associated with the various species of tsetse found there, so need not reiterate these observations here. Briefly summarised, these might be given as follows:—*G. palpalis* is found along the banks of rivers where vegetation is dense, in "kurimis" (dense bush with abundant shade), and along the banks of the smaller tributaries. *G. tachinoides* is an up-country form allied to *G. palpalis*, and is found in similar localities on the higher reaches of the rivers. *G. submorsitans* is seldom found near rivers and is more abundant in the savannah forest and open savannah country; I have found the species at least three miles from the nearest water. In very open country where small water-holes exist, *G. submorsitans* is more frequent, but this may be, and probably is, because game comes to water there. *G. submorsitans* will, however, follow a herd of game a long distance, and undoubtedly migrates in this manner.

* Bull. Ent. Res., v, p. 87

Relation to Game.—Lloyd has drawn attention to the fact that where game is plentiful 13 per cent. of female *G. morsitans* were caught, whereas where game was not plentiful 41·5 per cent. of females were taken. This relationship is confirmed by my observations in West Africa. At Larabanga game is extremely abundant, and during 22 days' collecting in July and August the percentage of females was 9·2. At Murugu, on the other hand, where native hunters are numerous and game consequently scarce, the percentage in June was 54, while in August it was 15. Lloyd also remarks that when game is plentiful the number of pupae taken daily was 31, whereas where game is not plentiful the number was only 7. This is also borne out in West Africa. These two facts, contradictory as they may seem, are yet easily accounted for, and are what one would expect. Where game is abundant the females manage to feed easily, and when fully gorged retire to the seclusion of some shady place, consequently the number of females seen and caught is diminished. Following on this is the fact that if the females feed easily they propagate more rapidly, consequently the number of pupae is increased.

All over the Northern Territories the close association between *G. submorsitans* and game is very marked. Wherever game is abundant, there tsetse will be in like proportion. I have elsewhere remarked on the fact that my attention has frequently been drawn to the presence of game by observing an increase in the number of tsetses. The table showing the proportion of the sexes in *G. submorsitans* will bear out this association, e.g., at Larabanga, where game is plentiful, the average daily number of *G. submorsitans* taken was over 100, whereas at Murugu (between Larabanga and Daboya) where game is kept under by native hunters the daily average was about 50. The nature of the fauna and its association with tsetse has often been commented upon, but in West Africa I have never seen any marked disparity in the number of *G. submorsitans* associated with buffalo or warthog, although I have followed and shot practically every species of game in the country. I have elsewhere remarked on the close association between *G. submorsitans* and the dog-faced baboon (*Papio sphinx*), and this fact was again brought to my notice during my past tour. At one camp where my collectors brought back very few tsetse, I naturally enquired the reason, and they explained that there were no monkeys. Now as my carriers that day caught a small monkey I pointed this fact out to them, but they explained that it was not the small monkeys they meant, but the dog-faced baboons. They also said that where the baboons were abundant tsetse were also abundant. This fact is difficult of explanation, as it is highly improbable that tsetse feed on these animals, yet if such an association be established, the question of exterminating tsetse by the destruction of game becomes exceedingly more difficult.

Meteorological Conditions.—I have elsewhere discussed this question *in extenso*, but would point out that humidity is the prevailing factor influencing the numbers of tsetse. At the beginning of the dry season these insects increase greatly in numbers. Whereas actual sunshine only affects the daily period of activity, a hot sun most strongly affects *G. palpalis*, which seldom follows one in direct sunshine. *G. tachinoides* is next affected, whereas *G. submorsitans* will follow and attack in the open in the hottest sun, but seldom at night. Roubaud states that *G. morsitans* when exposed to a temperature of 40° C. (104° F.) died within an hour. This I did not find to be the case in the Northern Territories. I have frequently caught them in the open at

a temperature of 109° and 112° F. For this reason, when cattle, horses, and other animals have to be transferred from one place to another, this should be done if possible during the night.

II. *Glossina palpalis* var. *pallida*, var. nov.

One of the greatest difficulties I experienced in identifying tsetse was in regard to a small variety of *G. palpalis*. This variety was first found by me in the upper reaches of the River Gambia. At that time (1911) I reserved an opinion as to its identity. Subsequently, Dr. Macfie found them in large numbers in the Ilorin province of Northern Nigeria. In his report on that province (Bull. Ent. Research, iv, p. 13) he makes some observations on the characteristics of the variety and gives an excellent illustration of it (Plate vii). At Yapi I found very few typical *G. palpalis* but large numbers of this variety. It is almost identical in size and markings with *G. tachinoides*, but an examination of the genital armature of a very large number leaves one in no doubt as to its identity with *G. palpalis*. When females are gorged with blood, however, or have become discoloured, it is almost impossible to distinguish them.* The variety is so distinct in size and markings from *G. palpalis*, which prior to Newstead's study of the genital armature were the only specific characters, that I think it advisable to give some distinctive name, such as var. *pallida* to this race. It is especially worthy of note that no intermediate forms exist between this variety and typical *G. palpalis*.

III. Food of *Glossina*.

The question as to whether tsetse are entirely dependent on blood for their food supply, and if so, what blood is most acceptable, calls for some comment.

Several writers have devoted much space to this question, but the problem is far from being actually solved. Bruce and others in discussing the matter cite the following cases in regard to *G. palpalis*:—(1) in 60 flies in which blood was found, 20 contained mammalian, 9 non-mammalian, and 31 unrecognisable blood; (2) in 108 other flies, 7 contained mammalian, 35 non-mammalian, and 66 unrecognisable blood.

With regard to the latter instance they note that reptilian was twice as frequent as avian.

Yorke and Blacklock give the following data from Sierra Leone:—

Flies.	Mammalian.	Nucleated.
113	8	0
87	6	2
—	—	—
200	14	2
—	—	—

These figures show great discrepancies; e.g. in Bruce's first record the proportion of mammalian to non-mammalian is over 2 to 1; in his second the proportion is as 1 to 5; while in Yorke and Blacklock's observations the proportion is 7 to 1.

* [In *G. tachinoides* the third joint of the antenna is noticeably shorter and its anterior edge is less curved.—ED.]

With regard to *G. morsitans* the following data are available. Bruce in his Report of the Sleeping Sickness Commission of the Royal Society states that out of 500 flies examined 288 or 57·6 per cent. contained mammalian blood, while only three contained nucleated corpuscles, and two contained a mixture of both. Of 30 female flies examined he states that 13, or 43·3 per cent. contained mammalian blood. In another experiment he notes that 99 per cent. contained mammalian blood and only 1 per cent. avian.

Lloyd states that out of 67 flies examined 24 per cent. contained mammalian blood, and 7·4 non-mammalian.*

Eminson in 1914 found that out of 500 flies examined there was blood in 43 ; in 41 there was mammalian blood, and two contained non-mammalian.

This would tend to show that *G. morsitans* is much more dependent on mammalian blood than is *G. palpalis*. I had very little opportunity of studying the latter species in large numbers, but several thousands of *G. tachinoides* were examined microscopically for stomach contents. In none of these could I detect anything of a vegetable character. At Yapi 1,289 *G. tachinoides* were captured containing blood. The percentage of mammalian and non-mammalian blood in the different batches examined varied considerably, but taking the observations as a whole the result was as follows : Mammalian 67·3 per cent., non-mammalian 32·7 per cent.

Other observations at different places gave the following figures :—

Flies.	Mammalian blood.	Non-mammalian blood.
375	59 %	41 %
287	68·5%	31·5%
329	74·3%	26·7%

It must be remembered that out of those taken with mammalian blood a certain number must be deducted, as undoubtedly many of them had bitten the collectors. This fairly exhaustive experiment goes to show that non-mammalian blood forms a distinct food supply for *G. tachinoides*, and the point is raised : What is the source of this food supply ? In my animal house at Yapi I kept various types of reptiles, including the puff adder (*Bitis arietans*), black cobra (*Naia nigricollis*), the yellow-spotted monitor (*Varanus niloticus*), and the common crocodile (*Crocodilus niloticus*), and have repeatedly seen *G. tachinoides* gorge itself on each and all of these species. This is especially the case after these animals have had a heavy meal and are very somnolent. On one occasion at Prang on the River Pru I came across a large sleeping puff adder on which one *G. palpalis* and two *G. tachinoides* were feeding.

Observations on birds were very different. Very few *G. tachinoides* managed to get a full meal from any of the species kept. They never fed on fowls unless these were tied down. This would distinctly point to reptilian rather than avian fauna as the source of food in the case of those found with nucleated corpuscles ; and reptiles are extremely common all along the river banks where *G. tachinoides* abound.

The source of the mammalian blood is not so easy of solution. Various species of small and large game come to the river in the mornings and evenings to drink, and of

* [In Northern Rhodesia, Kinghorn, Yorke and Lloyd record (Ann. Trop. Med. Paras., vii, 1913, p. 282) that out of 82 flies containing recognisable blood, 12 (or 14·6 per cent.) contained nucleated red cells.—E.D.]

course numbers of them must be bitten ; but although the river banks everywhere abound with baboons and monkeys, I think it highly improbable that these form a source of food supply. I kept two *Cercopithecus patas* for nearly two years, and never once did I see a tsetse manage to feed off them. Even when apparently asleep, the monkeys at once disturbed the tsetse on alighting, and in the great majority of cases succeeded in catching and devouring them. There is, however, one small mammal which is extremely abundant on the banks of the Volta River, and that is a large yellowish brown bat. These animals sleep during the day in a suspended position in the dense overhanging trees in localities similar to those where *G. tachinoides* abound, and I am inclined to think that, apart from the human supply, these animals are the chief source of the mammalian blood supply.

I carried out a large series of experiments to find out whether tsetse ever imbibe water, but in none of these could I definitely say that such was the case. I used several tubes containing citrated blood, pure water and various coloured liquids, each covered with a membrane of rat's skin. Although at different times tsetse pierced each of these membranes, in no case could I say that any liquid was imbibed except the fresh blood. Never have I seen a tsetse drink an exposed liquid. *G. tachinoides*, just like *G. morsitans*, seems to prefer piercing before sucking. Several experiments with fruit, e.g., ripe pawpaw, mangoes, and ripe marrows also proved negative. Although the tsetse were seen to pierce the skin, never did I actually see any liquid being absorbed.

The percentage of mammalian blood to non-mammalian differs greatly in the case of *G. submorsitans*.

Out of 987 tsetse examined with discernible blood in the stomach, only 23 contained non-mammalian blood, i.e., only 2·3 per cent. The reason for this is not far to seek. In the open country away from water where *G. submorsitans* abounds, there is practically no reptilian fauna, so that it is lack of opportunity rather than preference which decides the matter. To test this I put large numbers of *G. submorsitans* into cages with different reptiles and nearly all fed voraciously and had distended abdomens, especially in the early morning.

A point of interest which obtruded itself on me on several occasions was that when an animal had been shot, tsetse and Tabanids often alighted on the carcase. Although the Tabanids frequently drank from the open wound, tsetse were never seen to do this, but always pierced the skin, and so imbibed. This leads one to suppose that *G. submorsitans* never drinks exposed liquids.

IV. Disparity in the Proportion of Sexes in *Glossina*.

The question of the disparity in the proportion of sexes in *Glossina* has attracted the attention of many observers in various parts of Africa.

Dr. R. E. McConnell (Bull. Ent. Res., iii, p. 58) was impressed by the apparent marked numerical superiority of males along the large rivers, and of females on the smaller streams. He quotes as an example that of 40 specimens of *G. palpalis* (*fuscipes*) taken in October on the Nile, 35 were males and 5 females, while of 77 taken in July 67 were males and 10 females. He goes on to point out that of 56 flies captured in September near the mouth of small tributaries of the Nile 24 were males

and 32 females, and expressed his opinion that if this last batch of flies had been taken some 20 miles upstream the females would have outnumbered the males to a much greater extent.

Dr. J. B. Davey (Bull. Ent. Res., i, p. 145) states that of 117 *G. brevipalpis* captured during the evenings at Kaporo in Nyasaland, all were males, whereas of seven caught in the same place about mid-day four were males and three females.

Bequaert gives a further reason for the disparity in proportion of sexes, and in discussing *G. palpalis* says that in inhabited regions the sexes are in about equal numbers, whereas in uninhabited regions there is a distinct preponderance of males. He says this may be due to the fact that food supplies are more scarce in the latter districts and therefore the more active male is more in evidence.

Kinghorn and Montgomery report the following catches of *G. palpalis* on the island of Matondwi, near the southern shore of Tanganyika :—

			♂		♀
July	1,282	(91 %)		127	(9 %)
November	396	(98·8%)		5	(1·2%)

Newstead (Report S. S. Comm. of Royal Society, No. 15) gives the following table with regard to *G. morsitans*.

Month.	No. of Days Flies examined.	Total Flies.			Meteorological Condition.
August 7-29 ..	7	87	80·5	19·5	Very dry.
Sept. 1-30 ..	22	346	81·6	12·4	„ „
Oct. 1-16 ..	11	206	90·8	9·2	„ „
Oct. 17-31 ..	11	165	68·5	31·5	Very heavy rains.

Thus we have such hypothetical reasons to explain the disparity in the proportion of sexes, as (1) the size of the river on which the tsetse were caught, (2) the time of capture, (3) the number of inhabitants in a given area, and (4) the season of the year and meteorological conditions.*

To all of these I paid special attention during my recent tour. As, however, at certain times I was in an area where *G. tachinoides* predominated and at others where *G. submorsitans* predominated, I was unable to make a consecutive study of either.

The number of days spent in collecting as a basis for percentages has a very direct bearing on the validity of such deductions ; e.g., at Yapi from 1st to 12th June, 1916, 856 males and 767 females were caught. This works out at 52·8 per cent. of males and 47·2 per cent. of females. Now let us break up this period into three shorter

* [A much more probable explanation of this disparity has been given independently by Lt. Lloyd (Bull. Ent. Res., iii, p. 235) and W. A. Lamborn (Bull. Ent. Res., vi, p. 250 ; and vii, p. 39).—ED.]

periods, say 1st to 4th June, 5th to 10th June, and 11th to 12th June. The numbers and percentages are as follows:—

		♂	♀
1st-4th	June	206 (52.1%)	189 (47.9%)
5th-10th	„	523 (60.4%)	343 (39.6%)
11th-12th	„	127 (35.1%)	235 (64.9%)

Now the enormous disparity in the percentages in these three periods compared with that in the total period is very marked. Consequently, were one to take any one of these short periods as a basis for deduction, the conclusion would not be in any way in accordance with facts over a longer period.

The longer the period over which observations are made, provided the meteorological conditions are fairly constant, the greater will be the validity of the conclusions. Again, *the larger the number caught, the greater will be the chance of coming to a definite decision.* This is almost a truism, but it has been so much overlooked that it is worthy of emphasis here.

Now let us take some definite cases, *e.g.*, at Yapi. The following are the results of prolonged investigation:—

			♂	♀	Total No. examined.	Rainfall.
June 1914	..	..	70 %	30 %		
July 1914	..	..	57 %	43 %		
Sept. 1915	..	..	56.5%	43.5%	2,876	8.34
Oct. 1915	..	..	46.5%	53.5%	3,526	2.66
Nov. 1915	..	..	47.5%	52.5%	3,497	nil
Dec. 1915	..	..	50 %	50 %	2,985	nil
1-12 June 1916	..	..	47.2%	52.8%	1,733	2.71
3-12 Sept. 1916	..	..	64 %	36 %	183	4.63

It will be seen from the above that the greatest disparity in the proportion of sexes occurs during the period of greatest rainfall.

Now at Daboya the following are the results:—

			♂	♀	Total No. examined.	Rainfall.
29, 30. iii. 16	..	..	60 %	40%	142	1.54
21, 27. vi. 16	..	..	58%	42%	907	5.33
23, 24. vii. 16	..	..	50%	50%	215	5.44

The results here obtained are almost in direct contradiction with those previously shown for Yapi.

Again, take the case of Gnani and Danio in Togoland. These places are practically identical in every way, yet at the former three days' collecting resulted in the following—127 males and 194 females; while at the latter the position was reversed, and 126 males were caught to 114 females.

On the River Lora between Larabanga and Daboya, in April 1916, the proportion of males and females was as 51·5 to 48·5; rainfall 4·77. This river satisfies two of the conditions insisted on by McConnell and Bequaert. It is a small tributary of the Volta, and it is several hours from the nearest village, consequently uninhabited. Yet in the case of *G. tachinoides*, if we may judge from the results here found, neither of these factors has any bearing on the proportion of the sexes. But it is only right to point out that these authors were dealing with *G. palpalis*.

At Zantana (N. of Daboya) in the same month, April, the relation was 57 per cent. males and 43 per cent. females. This village is also on a small tributary of the Volta, but the difference in percentages of the sexes is not appreciable.

At Gwa, a small village S.E. from Daboya far removed from the River Volta, in March 1916 the proportion was as 62 to 38 per cent.

At Kito, a similar locality, a little further south in the same month the proportion was as 65 to 35 per cent.

The one outstanding feature which these figures exhibit is that the percentage of males decreases as the rains gain in intensity and the humidity increases. (Compare this with *G. submorsitans*).

Now let us consider the case of *G. submorsitans*, and see how far the proportion of sexes is in accordance with the figures found for *G. tachinoides*. The following table has been prepared for various localities in the Northern Territories at different seasons.

It will be seen that Larabanga was visited at four different periods in July and August, but that the percentages are practically the same. In the case of Murugu and Kapoto (some miles S.W. from Daboya) the difference between June and August requires some explanation.

				Percentage.		
Larabanga	1-7. vii.16	721	100	}	90·8	9·2
" " " "	14-18. vii.16	546	47			
" " " "	25-28. vii.16	202	9			
" " " "	15-21. viii.16	816	78			
Kabampwi	29. vii.16	52	4	}	90·7	9·3
Guripe	30. vii-3. viii.16	300	33			
" " " "	11-14. viii.16	69	6			
Murugu	31. vi.16	25	29	}	46	54
" " " "	21. viii.16	46	8			
Yarizori	22. viii.16	58	4			
Kapoto	28. vi.16	80	52	}	60	40
" " " "	23. viii.16	109	5			
Kofaba	4-9. ii.16	261	76			
Larabanga Bush Camp I.	14-20. vi.16	660	38	}	94·5	5·5
Larabanga Bush Camp II.	23, 24. v.16	268	14			
Larabanga Bush Camp III.	8-13. vii.16	336	36			

From the foregoing table it is quite evident that there is a much greater disparity in the proportion of the sexes of *G. submorsitans* than in the case of *G. tachinoides*. The general average ranges from 90–95 per cent. of males, but there are certain discrepancies; e.g., at Murugu in June the percentage of males was only 46, while in August it was 85. This is probably accounted for by the greater rainfall between June and August than in the preceding months. The same may be the case in October and November at Yapi, and it would certainly be accounted for in the case of Kofaba in February. It is worthy of note that at Kapoto the percentage of males in June was also low, viz., 60. This is in distinct contradiction to the percentages found by Newstead in corresponding seasons in Nyasaland. It is worthy of note, however, in connection with Newstead's figures, that the two last numbers given by him (see page 200) are only for a period of over two weeks. Now, although there were very heavy rains during the latter fortnight, it would not materially affect the number of *G. morsitans* in so short a time. Had he taken the whole month's collection together, the percentage would have been approximately the same as in the corresponding two months. This is a clear case, I think, of false deduction from over-subdividing.

In May, however, when I visited the two Bush Camps at Larabanga the percentage of males was even higher than at Larabanga in July and August. This is anomalous, and I will venture no solution, but would only note that these districts were greatly overrun by game. It may be that the food supply was very plentiful and that the females were well fed and therefore more retiring, whereas the greater number of males caught would be accounted for by their being on the look-out for females. This seems to me a more feasible explanation than that given by Bequaert.

V. Flight Experiments with *Glossina*.

In order to ascertain whether *Glossina tachinoides* liberated at some distance from the river would return to it, I performed a series of experiments by marking a number of specimens by means of cutting off the two terminal tarsi of the various legs. Altogether in these experiments about 3,000 specimens were used. On the road from Yapi to Tamale there are two small streams, about two miles from Yapi, which are dry in the dry season but contain a considerable amount of water in the wet season. Notwithstanding this latter fact, very few *G. tachinoides* are to be found on the banks. They seem to prefer the larger river.

In the first experiment in the dry season I liberated 150 specimens at each of the following distances, 1 mile, $1\frac{1}{2}$ miles, 2 miles, 3 miles, 4 miles and 5 miles along the main Yapi-Tamale Road. Of these, 59 per cent. liberated at 1 mile were again recaptured, 15 per cent. liberated at $1\frac{1}{2}$ miles were again caught, while of those liberated at 2 miles only 5 per cent. were retaken on the river bank. Of those liberated at 3 miles and 5 miles, none were taken; while only one liberated at 4 miles was recaptured. None were taken further away from the river than where they were liberated.

When this experiment was again repeated in the wet season, 47 per cent. of those liberated at 1 mile were retaken, 25 per cent. of those liberated at $1\frac{1}{2}$ miles, and 10 per cent. of those liberated at 2 miles. On the other hand, an examination of the banks of the stream at the different seasons showed a marked disparity.

During the dry season, when there was no water in the stream, only 3 per cent. of those liberated at 2 miles, 8 per cent. of those liberated at 3 miles, and 6 per cent. of those liberated at 4 miles were again caught, and that at no great distance from the road. None of those liberated at 5 miles were again seen.

In the wet season, however, when water was abundant in the stream, 10 per cent. of those liberated at 2 miles, 13 per cent. of those liberated at 3 miles, 9 per cent. of those liberated at 4 miles, and 6 per cent. of those liberated at 5 miles, were again captured.

Before being liberated, these tsetse were all fed as far as possible, and the cages containing them were taken out at night and left open. It was found that by 2 a.m. all the tsetse had escaped. Of course it must be remembered that there is considerable traffic on this road, and many of these tsetse may have followed the natives for some distance.

However, from these experiments the following deductions may be drawn :—

- (1) The greatest distance covered by a single tsetse was four miles.
- (2) Apart from this none returned over two miles.
- (3) All seemed to return to the water, as none were caught at a greater distance from the river than where they were liberated.
- (4) If there was any intermediate water between where the tsetse were liberated and the large river, the tsetse discovered this and were making their way down stream to the large river.
- (5) Where there was shade on the bank of a stream but no water, the tsetse congregated there, but did not attempt to proceed towards the large river.
- (6) A thorough examination of the open bush on each side of the road revealed not a single tsetse at a greater distance than 200 yards.
- (7) There was practically no discrepancy in the proportion of the sexes recaptured ; if anything, there was an excess of males, but the numbers were too small to be of value.

It must be remembered that these numbers may not—in fact, cannot—actually represent the number of tsetse which really returned. The percentages must therefore be taken not as absolute, but as proportionate.

I then tried a similar experiment in the open bush, but found that this was practically impossible owing to the various directions in which the tsetse might return to the sinuous river, and the impracticability of patrolling the whole area.

On another occasion I liberated 1,000 tsetse at distances varying from one to ten miles, along the bank of the river. It was found impossible to collate the returns, but the greatest distance covered by an individual tsetse was seven miles, while numerous flights of 2–4 miles were observed. It is more than probable, however, that these followed the numerous canoes which constantly ply on the river. I have already shown in my various reports the great attraction moving objects have for tsetse.

Of a large number of tsetse liberated at Yapi in September and October 1916, some were taken as late as December 1916, while one was captured 15 miles down the river in January 1916. This is evidently a clear case of a tsetse following a canoe. While tsetse liberated on one bank have been captured on the other, I have not been able to ascertain the total distance covered in one distinct flight.

In all, ten experiments were tried to test how far tsetse will follow a herd of game—five original and five repeats. Fifty tsetse (*G. submorsitans*) were used in each experiment. A herd of cattle passing along a road was selected and the tsetse were liberated in the centre of the herd. In the first set of experiments, the tsetse were not molested; but it must be remembered that cattle are much easier victims to tsetse than are wild game. In the second set, a number of boys with fly switches were ordered to keep disturbing the flies when seen to alight.

The results of these experiments are as follows :—

After one mile	(1) 21 were recaptured.	(6) 29 were recaptured.
„ two miles	(2) 10 „ „	(7) 17 „ „
„ three „	(3) 7 „ „	(8) 12 „ „
„ four „	(4) 3 „ „	(9) 7 „ „
„ five „	(5) 0 „ „	(10) 0 „ „

From this series of experiments it will be seen that after five miles have been traversed the tsetse have either all managed to feed, or have given up the attempt and disappeared.

VI. Trapping of *Glossina*.

The question of how to diminish the number of tsetse in any definite locality is of paramount importance. It has repeatedly been shown that in the case of villages a clearing of about 400 yards around the outer circumference of the village will practically restrict the tsetse to a region outside this area. This, as Mr. T. E. Fell has pointed out, should be undertaken only when such a clearing can be maintained, otherwise a lower, shorter and more scrubby type of vegetation will arise which is very suitable for the flies. The same must apply to fords of rivers and the main roads in a district. This then should be undertaken only in definite localities where the supply of labour is adequate. In a restricted area, as for example the Island of Principe, such a scheme as systematic trapping has had very beneficial results; but, in wide areas, such as any of the colonies of West Africa, the conditions are totally different. Take, for example, a small portion of the River Volta between Yeji and Yapi. After a week's examination of this part of the river, I am confident in saying that there is not one half mile in this whole area where *G. tachinoides* is not to be found in quantity. There is a constant stream of canoes plying on the river, and it is now certain that tsetse follow these canoes considerable distances. My own experiments have shown a distance of seven miles, and this cannot be regarded as the maximum. Consequently, to attempt to clear this region of tsetse would mean expense out of all proportion to the advantage gained, because the supply on either side would constantly tend to repopulate the whole area.

At the Yapi ferry I posted five men for four months for the purpose of ascertaining if there would be any diminution in the number of tsetse at the end of that time. The following are the results :—

1st-23rd Sept. 1915,	2,876 tsetse caught	or 125 per day.
1st-31st Oct. 1915,	3,526 „ „	or 114 „ „
1st-30th Nov. 1915,	3,497 „ „	or 116 „ „
1st-23rd Dec. 1915,	2,985 „ „	or 129 „ „

Again, between 22nd February and 23rd March 1916, another test was made with the following result :—3,842 tsetse were caught, or 128 per day. From 21st November to 23rd December, 4,392 tsetse were caught, or 133 per day.

It must be remembered that collectors were working in this area at several intervening times, so that one is fairly justified in concluding that systematic trapping is out of all question in such an area.

This, it must also be remembered, was accomplished by trained, well paid, fully equipped collectors, and I am of opinion that if the whole population in the area suggested were put on to this work, there would be no appreciable diminution in the number of tsetse. The expense, too, would preclude such an undertaking being attempted.

Systematic trapping with bird-lime I found to be less satisfactory than by means of nets. Four colours of paper were used—light brown, red, black waterproof, and green. These were most satisfactory in the order given.

The following are the average numbers captured daily, five men being used for each colour :—Light brown, 103 ; red, 89 ; black waterproof, 79 ; green, 45.

In my Gambia report* I have already shown the marked preference of tsetse for black over white in clothing.

I then tried liberating tsetse in an enclosed room and smearing the bodies of collectors with the following oils and essences :—oil of bergamot, oil of cloves, beechwood oil, oil of lavender, cedarwood oil, beechwood creosote, essence of oranges, and essence of lemon. The tsetse were allowed to alight on and bite the collectors, and only in two cases did these substances seem to act as a deterrent, viz., beechwood creosote and beechwood oil. In the case of oil of cloves and the two essences there seemed to be a marked attraction. The large quantities of these preparations required precluded the experiments from being carried out on a large scale.

Beechwood oil smeared over the hands and face acts as a deterrent to mosquitos so long as the fumes persist.

VII. Natural Enemies of Tsetse.

The conservation or increase in the numbers of the natural enemies of tsetse is a subject which might well repay consideration. Guinea-fowl and bush-fowl have been mentioned by some writers, especially the late Professor E. A. Minchin. He recommended that these species should be conserved and their range extended, as owing to their scraping habits it was more than probable that they would feed on and destroy tsetse pupae. To test the validity of this hypothesis I examined the stomach contents of 379 of these birds. I found that by far the greatest proportion of the food of both species consisted of guinea-corn and other seeds. From the animal kingdom the following were found, beetles, Syrphid flies, Mantids, ants, bugs, grubs of various sorts, millipedes, grasshoppers, Hymenoptera, molluscs, etc., but in no case did I see any remains of either adult tsetse or pupae.

An examination of the stomach contents of lizards revealed numerous kinds of insects, but never of tsetse. The same is true of the nests of mason wasps. Tsetse are not "fleshy" insects and are therefore unsuitable as a food for growing larvae.

* Bull. Ent. Research, ii, p. 210.

Bequaert mentions the case of a carnivorous spider as a natural enemy of tsetse, whilst I myself found a predatory Attid spider, *Plexippus paykulli*, And., capturing *G. palpalis* on the Government steamer on the Gambia.*

Dragonflies have also been seen devouring tsetse, but by far the most important insect enemies are Asilid flies and wasps of the genus *Bembex*.

Four species of the former were captured by me with tsetse in their grasp. One of these is an undetermined species of *Asilus*, while the others are indeterminate both as regards genus and species. Although several species of ASILIDÆ have been seen capturing and devouring tsetse, some take to it more readily than others. I caught a large number with *G. tachinoides*, but very few with *G. submorsitans*. At one place on the Lora River, between Daboya and Larabanga, I fitted up a large mosquito net and enclosed in it numerous tsetse and a few ASILIDÆ. It was noted that most of the tsetse were caught on the wing, only a very few being taken while resting. When an Asilid captures a tsetse, it becomes so engrossed in its prey that it is possible to approach it very closely and note its *modus operandi*. They seldom fly any great distance after a capture, but alight on some small adjacent twig. Grasping the twig on both sides with the tarsi of all six legs, the Asilid presses the abdomen of the tsetse with all its femora, and inserts its proboscis into the thorax. Although the abdomen be distended with blood, the Asilid very seldom punctures it, but presses the blood into the thorax, and there abstracts it. On a very few occasions I saw the Asilid transfer the proboscis from the thorax to a point between two segments of the abdomen, and suck the blood from there.

The toll of tsetse taken by ASILIDÆ is considerable. They follow cattle and horses long distances, and I have repeatedly seen an Asilid grasp a tsetse about to alight on a horse's neck. Sometimes they will hold a fly for over a quarter of an hour, occasionally shifting the position of the proboscis five or six times. I have also seen them relax their hold of the twig when disturbed, fly away with the tsetse and return to almost the identical spot again. Of 24 tsetse put into a mosquito net with six ASILIDÆ, all were dead within 24 hours, and all showed signs of having been punctured.

Bembex is the most voracious enemy of *G. submorsitans*. These insects seem to abound more in the open country than in the shady regions inhabited by *G. tachinoides*. Roubaud states that a species of *Bembex* attacked and captured *G. longipalpis*, but was not seen in the *palpalis* area. On one occasion at Larabanga my pony was surrounded by *G. submorsitans* and also small Tabanids.† Numerous *Bembex* were hovering about and not a few tsetse were captured, although in no case did I see the *Bembex* attempt to take the Tabanids. The *Bembex* does not alight, but darts quickly down and either captures the tsetse on the wing or immediately it has alighted. I tried an experiment with tsetse and *Bembex* in a mosquito net in all respects similar to that with tsetse and ASILIDÆ, with the same results.

Thus the ASILIDÆ are the chief insect enemies of *G. tachinoides* and *Bembex* of *G. submorsitans*. Whether or not it would be feasible to breed and disperse these insects it would be highly injudicious to state categorically.

* Bull. Ent. Research, ii, p. 210.

† See section (m).

VIII. Breeding Places and Habits of *Glossina*.

The two species of *Glossina* with which I was intimately associated during the past tour were *G. tachinoides* and *G. submorsitans*, so that the following remarks apply entirely to them. Zupitza and Yorke & Blacklock have given some details of the breeding places of *G. palpalis*, but so far I do not think that any work has been done on the two above-mentioned species in West Africa.

On my arrival in the Northern Territories in September 1915 I established my camp at Yapi, and studied *G. tachinoides* almost exclusively. Exhaustive searches along the river bank during that time revealed only a few empty pupal cases, but no live pupae. Despite this fact, females kept in my laboratory produced pupae which matured and developed in due course. The humidity was diminishing and the temperature increasing during this period, and it was found that as this took place the pupal period diminished. The longest time taken by a pupa to hatch was 49 days, and some pupae deposited 25 days after these developed before them. The shortest time taken by a pupa to develop was 22 days. From the pupae deposited in September only 41 per cent. came to maturity, while of those deposited in November 87 per cent. produced adults. Males and females appeared in practically equal numbers, but the males died off much more quickly than the females. The mortality amongst the males was 35 per cent., amongst the females only 17 per cent. These numbers refer solely to those which died before taking a meal. In January I made an examination of the river between Yapi and Yeji, and again I searched assiduously for pupae at various places, with the same result. I returned to Yapi on 22nd February, and remained there till the 23rd March. During this period I obtained 447 pupae of *G. tachinoides*. Of these 392 produced adults (189 males and 203 females) and none were parasitised.

The breeding places of *G. tachinoides* seem to agree fairly closely with those of *G. palpalis*. Zupitza, at Duala in the Cameroons, found pupae in the angles of leaf-sheaths of palms. Yorke and Blacklock never found them there in Sierra Leone, but they found them on the ground around the bases of palms. No palms exist at Yapi, but between Kofaba and Yapi Borassus palms are fairly abundant in some places. A careful search in both positions at these places failed to reveal pupae of *G. tachinoides*.

The most common situation for the pupae of *G. tachinoides* is in the decaying humus beneath overhanging trees, in places which are quite sheltered from heavy rains and which would be moistened only occasionally by water dripping down. The sun seldom or never penetrates to such positions, and the ground is never really dry. Although this species is very abundant amongst tall grass, I have never found breeding places in such localities, nor have I found them in places which are liable to be flooded at any period of the year. On these occasions I found pupae in hollows of decayed trees, and a more common position is in a collection of decaying leaves in the axils of branches, or in a similar collection at the fracture of a branch which had become partly detached.

On my return to Yapi on 31st May another search was made, and between this date and the 11th June, 217 pupae were obtained. From these 87 females and 93 males emerged.

Between 20th September and 14th October, only 23 pupae were obtained, and between 21st November and 23rd December only 17 pupae were found, although the same and similar places were examined.

This would tend to show that the principal breeding season of *G. tachinoides* is just after the dry season when the rains commence, and that at the end of the rainy season breeding practically ceases.

The breeding places of *G. submorsitans* are very similar to those of *G. tachinoides*, with the exception that on several occasions I have found pupae on the clusters of small growth on the top of deserted anthills, and twice under the overhanging rocks on a scarp at a bush camp at Larabanga.

Lloyd notes that pupae of *G. morsitans* were found in burrows of bush-pig and wart-hog. I have never found them in such situations, nor in the burrows of porcupines, which are fairly numerous in the Northern Territories.

At Larabanga, prior to my finding pupae in their natural position, I felled several large trees and surrounded them with a mass of undergrowth, and was successful in inducing *G. submorsitans* to deposit larvae there. On one occasion I saw a female deposit a larva. She took up her position on the underside of the trunk about an inch from the ground and thence let the larva drop. Within five minutes the larva had penetrated the soil and had disappeared.

Pupae of *G. submorsitans* were found at Yarizori, Murugu, Larabanga, Larabanga Bush Camp, Kabampwi and Guripe, all on the Daboya-Bole Road. None were found at Kofaba, or between Kofaba and Yapi. This may be accounted for by the season of the year, namely, January.

From the pupae found (in all 947) 821 adults emerged. Of these 402 were males and 419 females; 679 gorged themselves with blood, while 124 died before feeding. The males died off much more quickly than the females. Roubaud mentions that he noted intra-uterine pupation; Kinghorn never saw it; I observed it on four separate occasions.

Lloyd states that on one occasion driver ants entered the bottles containing pupae, and that none were damaged. I tested this with eight different species of ants, all with the same result. After prolonged observation, I agree with Lamborn that the viscid fluid around the larva is a protection against carnivorous enemies. The ants approached them, but backed away quite hurriedly before even touching them.

IX. Parasites of Pupae of *Glossina*.

Up to the present time no parasites of the pupae of tsetse have been described from West Africa. Now, as I have already shown, there is little hope of the extermination or even diminution of numbers of *Glossina* by trapping or other methods of destruction. Our only hope in this direction is the systematic breeding of parasites and their dissemination in fly-infested areas. Of course, such an experiment would have to be continued over a long period before any definite result could be expected.

From September to December 1915, I found a large number of pupae of *Glossina tachinoides*, but from them not a single parasite was obtained. Subsequent investigation showed that a small proportion of them were parasitised by *Chalcis amenocles*, Walk. This was the only parasite obtained from the pupae of *G. tachinoides*.

At the Larabanga Bush Camps and at Larabanga itself, between the 15th and 21st August, enormous numbers of pupae and empty pupal cases of *G. submorsitans* were found and from them the following parasites were bred out. These are given in their order of frequency:—*Chalcis amenocles*, Walk. ; *Dirhinus inflexus*, a new species which is being described by Mr. J. Waterston ; a Braconid which is being described by Mr. R. E. Turner as *Coelalysia glossinophaga* ; a species of *Odontomyia*, not yet identified* ; and a small Chalcid, which Mr. Waterston has not at present worked out.

In order to ascertain whether these species attacked only *Glossina* pupae, I placed the newly emerged parasites in bottles with larvae and pupae of several Diptera and also newly deposited larvae of *Glossina*. The result was rather astonishing, as very few of the *Glossina* pupae were attacked, whereas nearly every pupa of two species of *Sarcophaga* was parasitised. By this means I bred out several hundreds of *Chalcis amenocles*, and also large numbers of the other species. It is worthy of note that of a large number of pupae of *Sarcophaga* bred out, hardly a single specimen was parasitised in nature. This is not so surprising as might at first sight appear, as the localities in which these pupae are found are in the rubbish heaps and latrines around villages where tsetse are not common.

As species of *Sarcophaga* are everywhere abundant around villages, and as they breed prolifically, it would be possible in a very short time to obtain very large numbers of these parasites for dissemination.

X. Fauna of the Northern Territories.

The relationship between the parasites of game and domestic animals, as well as man, is a subject which has been attracting considerable attention in recent years. Although in West Africa much work has been done in this direction, practically nothing has been accomplished on the West Coast. Consequently, when the grass was burnt down and shooting became practicable, I spent a considerable time in the game area to find out what kinds of game harboured parasites, and what were the species of these parasites. By visiting the game area I was also able to compare the association between tsetse and game. A systematic examination of the blood of horses and cattle was also made for comparison.

The vertebrate fauna of the Northern Territories examined by me included:—5 hyaenas (*Hyaena crocuta*), civet, *Paradoxa* sp., porcupine, elephant, 1 hippopotamus, buffalo (*Syncerus nanus*), 4 haartebeeste (*Bubalis major*), 4 roan antelope (*Hippotragus equinus*), 4 waterbuck, 3 kob (*Kobus kob*), 1 reed buck (*Redunca redunca*), 1 bushbuck or harnessed antelope (*Tragelaphus scriptus*), 2 grey duiker (*Cephalophus scriptus*), 5 red-flanked duiker (*Cephalophus rufilatus*), 5 oribi (*Ourebia nigricaudata*), 1 red-fronted gazelle (*Gazella rufifrons*), 6 warthog (*Phacochoerus aethiopicus*), dog-faced baboon (*Papio sphinx*), red monkey (*Cercopithecus patas*), brown rat, several

[*Only a single specimen of this Stratiomyid fly was sent home by Dr. Simpson, and without any details as to how it was bred. Of the few species of *Odontomyia* whose life-history is known the larvae live in mud or damp earth or among decaying leaves and therefore the statement that Dr. Simpson's species is a parasite of *Glossina* would appear to need verification.—Ed.]

species of lizards, crocodile (*Crocodilus niloticus* and *cataphractus*), yellow-spotted monitor lizard (*Varanus niloticus*), puff adder (*Bitis arietans*), and black cobra (*Naja nigricollis*).

In the case of the baboon, monkey, civet, porcupine and *Paradoxa*, negative results were obtained by blood examination. When no parasites were found, guinea-pigs were injected, but the results were again negative. Consequently, we are fairly safe in asserting that no parasites were present.

In addition to those given in the foregoing list, I also examined two reed-buck, one roan antelope, one bush-buck, and one grey duiker, in July 1914.

It must be here pointed out that *Glossina tachinoides* calls for consideration as well as *G. palpalis* and *G. submorsitans*, as according to Bouet, Roubaud and Gallagher, the former species carries *Trypanosoma brucei* in its natural state in West Africa. Dr. Moiser also states that at Mulgue, near Maifoni, the natives assert that tsetse kill horses and cattle in that district, and this species is *G. tachinoides*. There can be little doubt that this is so, as it is the most common species on the upper reaches of the River Volta, and practically the only species at Yapi for the greater part of the year. I lost two ponies with trypanosomiasis at Yapi within a few months.

The following are the parasites identified in the blood of the animals shot. Of the three warthog shot at Kofaba on 6th February 1916, two contained a scanty infection of what was apparently *Trypanosoma pecorum*. Trypanosomes have already been found in the blood of warthog (Bevan). Several writers have noted the close association between tsetse and warthog, although in all fairness I must say that this fact has never been evident to me.

The reed-buck shot at Daboya on 10th April 1914 contained an undoubted infection of *T. vivax*. This fact is extremely important, as the animal was shot not 400 yards from the road and enormous numbers of cattle pass this road daily during the time when the river is low, on their way to Kintampo and Coomassie.

Of the reed-buck shot at the same place on the following day, Dr. J. W. S. Macfie, to whom I submitted the slide says:—

“The reed-buck had a few trypanosomes, some undoubtedly with a free flagellum. I only found a few parasites and it was not easy to make much of them, but I don't think they were *T. vivax*. I think they were of the polymorphic group which includes *T. gambiense*, *T. pecaudi*, etc. I did not of course find any posterior nuclear forms. All it is possible to say is that the trypanosomes appeared to belong to the polymorphic group (sometimes incorrectly called the *T. brucei* group), and that it is impossible to exclude the chance that they may have been *T. gambiense*.”

The blood of both of the oribi shot at Kabampwi on 2nd May 1916 showed a few piroplasms. They were exactly like *Theileria mutans*, very common in cattle in the Northern Territories. They were either *Theileria* (*Piroplasma*) *mutans* itself, or a closely allied species. Todd and Wolbach have noted a similar parasite in the roan antelope, which they called *T. hippotragi*, but I do not think one has previously been found in the oribi.

The blood of the haartebeeste shot at Gwa on 20th June 1916, and that of the red-flanked duiker shot at the bush camp at Larabanga on 10th July 1916, both contained a *Babesia* resembling *Theileria parva*.

It is interesting to note that out of the small number of animals examined no fewer than seven contained blood parasites, and that these animals belonged to five different species.

T. pecorum is common in cattle and has also been found in horses, while one of my ponies died with an infection of *T. vivax*. It is rather strange that no specimen of *T. congolense* was found in the blood of game, as a large number of cattle and horses examined by me were infected with this species, and I myself lost three ponies with this infection.

Although the blood of a number of hyaenas was examined, it is particularly striking that no *Leucocytozoon* was found.

XI. Human Trypanosomiasis.

During my stay in the Northern Territories only two cases of trypanosomiasis in natives came to my notice. One of these was a cook in the employ of Dr. Burgess at Salaga, and the trypanosome was undoubtedly *T. gambiense*. On Dr. Burgess' departure from the Colony I lost sight of the native, so cannot definitely state his progress.

The other was a constable in the Northern Territories' Constabulary in Tamale. He visited Dr. Graham, Provincial M.O. Tamale, with a temperature. Dr. Graham examined his blood and found a trypanosome. He gave him 5 grs. of atoxyl, and from that day onward never succeeded in finding another trypanosome. He wrote to me about the case, and I suggested that it might be a cattle trypanosome, non-pathogenic to man. A slide of the blood was sent to Dr. Macfie at the laboratory, Accra, who identified it as *T. vivax*.

XII. Blood-sucking Arthropods other than Glossina.

In order to demonstrate the distribution of these arthropods, the most satisfactory method is to take certain definite areas and show the species found in each locality. This list must be taken as supplementary to those given in my original Report on the Gold Coast.*

Tamale (the headquarters of the Northern Territories): *Anopheles costalis*, Lw.; *A. funestus*, Giles, *A. mauritanus*, Grp., *A. rufipes*, Gough, *Stegomyia fasciata*, F., *S. africana*, Theo., *S. luteocephala*, Newst., *Culicomyia nebulosa*, Theo., *Mucidus scatophagoides*, Theo., *Tabanus biguttatus croceus*, Surc.

Between Tamale and Yapi: *Tabanus biguttatus croceus*, Surc., *T. taeniola*, P. de B., *T. sticticollis*, Surc., *Cordylobia praegrandis*, Aust.

Yapi or Tamale Port: *Anopheles costalis*, Lw., *A. funestus*, Giles, *Stegomyia fasciata*, F., *S. africana*, Theo., *S. luteocephala*, Newst., *Mansonioides uniformis*, Theo., *M. africanus*, Theo., *Culex duttoni*, Theo., *Culicoides* sp., *Simulium damnosum*, Theo., *Chrysops distinctipennis*, Aust., *Tabanus biguttatus croceus*, Surc., *T. taeniola*, P. de B., *T. sticticollis*, Surc., *T. gratus*, Lw., *T. africanus*, Gray, *T. subangustus*, Ric., *T. ditaeniatus*, Mcq., *T. albipalpus*, Walk., *T. simpsoni*, Aust.

* Bull. Ent. Research, v, pp. 1-36.

Between Yapi and Yeji on the River Volta : *Tabanus biguttatus croceus*, Surc.,
T. taeniola, P. de B., *T. simpsoni*, Aust.

Between Yeji and Yapi (overland) :

Yeji : *Uranotaenia connali*, Edw.

Makongo : *Culex quasigelidus*, Theo., *Ochlerotatus nigeriensis*, Theo., *Tabanus sticticollis*, Surc., *T. gratus*, Lw.

Salaga : *Auchmeromyia luteola*, F.

Kofaba : *T. taeniola*, P. de B., *T. sticticollis*, Surc.

Tomaklaw : *T. biguttatus croceus*, Surc., *T. sticticollis*, Surc., *T. gratus*, Lw.

Between Daboya and Bole :

Larabanga : *Tabanus fasciatus*, F., *T. subangustus*, Ric., *T. taeniola*, P. de B.,
T. thoracinus, P. de B., *Haematopota beringeri*, Aust., *H. gracilis*, Aust.,
H. bullatifrons, Aust., *Hippocentrum versicolor*, Aust.

Guripe : *Haematopota* sp. near *tenuis*.

Dimawu : *Hippocentrum versicolor*, Aust.

Murugu : *Hippocentrum versicolor*, Aust., *Haematopota gracilis*, Aust., *Haematopota* sp. near *corsoni*, Carter.

Kunkwa : *Tabanus sticticollis*, Surc., *T. taeniola*, P. de B.

Togoland :

Gnani : *Tabanus fasciatus*, F., *Tabanus* sp.

Depoi : *Tabanus sticticollis*, Surc.

Bimbilla : *Tabanus sticticollis*, Surc.

Tali : *Tabanus biguttatus croceus*, Surc., *T. sticticollis*, Surc.

Chamba : *Tabanus sticticollis*, Surc.

The following are the five species of ticks and one species of louse which were obtained, with the names of the hosts on which they occurred.

<i>Hyalomma aegyptium</i> , L.	{	off roan antelope,
<i>Amblyomma variegatum</i> , F.		Larabanga,
<i>Rhipicephalus sanguineus</i> , Latr.		23.vii.14.

Rhipicephalus sanguineus var. *sulcatus*, Neum., off bush cat, Yapi, 26.vi.14.

Boophilus australis, Fuller, off roan antelope, Daboya, 23.vi.16.

<i>Hyalomma aegyptium</i> , L.	{	off warthog, Daboya, 13.vi.16.
		off roan antelope, ,, 21.vi.16.
		off roan antelope, ,, 23.vi.16.

Rhipicephalus falcatus, Neum., off warthog, Daboya, 13.vi.16.

<i>Rhipicephalus sanguineus</i> , Latr.	{	off roan, Daboya, 23.vi.16.
		off duiker, Gumpe, viii.16.

Haematopinus eurysternus, N., found on the eyelids of a cow at Yapi.

One of the most outstanding features with regard to the TABANIDAE is the large number of males which were captured at the height of the dry season and until a month before the rains. For example, in the case of *Tabanus sticticollis*, in December

1915, 37 ♂ were taken between Sankwalla and Tamale; 30 ♂ and 3 ♀ were captured at Tomaklaw in February 1916; 38 ♂ at Kofaba; 33 ♂ between Kofaba and Charma; 21 ♂ at Makongo and 5 ♂ at Yapi in the same month.

At Kofaba 187 ♂ and not a single female of *T. taeniola* were caught by two collectors in one morning around a small water-hole.

In January 1917, 73 ♂ of *T. sticticollis* were captured at Depoi in Togoland, 18 ♂ at Bimbilla, 23 ♂ at Tali, 10 ♂ at Chamba, and 9 ♂ at Kunkwa.

During the other months hardly a male is to be seen when females are very abundant.

NOTES ON THE ETHIOPIAN FRUIT-FLIES OF THE FAMILY
TRYPANEIDAE, OTHER THAN DACUS (S.L.), WITH DESCRIPTIONS
OF NEW GENERA AND SPECIES (DIPT.).—I.

By Prof. M. BEZZI,

Turin, Italy.

(PLATE V.)

While the Oriental* and Neotropical† Trypaneids have been the subject in recent times of extensive studies, those of the Ethiopian Region are still almost in the same condition in which they were left by H. Loew in his valuable paper of 1861.‡ Only more recently Prof. Hendel has made an attempt to erect some Ethiopian genera in his general classification of the family§; but all these genera are only shortly characterised by means of dichotomic tables, and most of their type-species have been given names as new species, but without any description.

The object of this paper is to give a summary account of our present knowledge of the classification and distinctions of the Ethiopian species of TRYPANEIDAE, with the purpose of facilitating further research in this very important family of flies.

The main material was submitted to the writer by the Imperial Bureau of Entomology, through the kindness of Dr. Guy A. K. Marshall, and is now to be found in the British Museum; while some of it has been accumulating from various sources and for many years in the private collection of the writer himself.

I have already given in 1908|| a catalogue of the Ethiopian Trypaneids described up to that time, with the enumeration of about 70 species (not counting *Dacus*); a considerable number of additional forms have however been subsequently described by Austen, Enderlein, Graham, Hendel, Lamb, Silvestri, Speiser and myself, thus bringing the total number of the known species to about 110 (always excluding *Dacus*). No doubt this number may be somewhat reduced by synonymy, but it is certainly much lower than that of the actually existing species; for in the Oriental and Australian Regions about 170 species (without *Dacus*) are known, and in the Neotropical, including Mexico and Central America (a region in which *Dacus* does not occur) about 250.

According to the classification proposed by me,¶ and accepted with slight modification by Prof. Hendel, the family may be divided into three subfamilies the DACINAE, the CERATITINAE and the TRYPANEINAE (TEPHRITINAE), to which

* M. Bezzi, Mem. Ind. Mus., iii, No. 3, May 1913, pp. 51–175, pl. viii–x.

† F. Hendel, Abh. Ber. K. Zool. Anthr. Mus. Dresden, xiv (1912), No. 3, June 1914, pp. 3–84, pl. i–iv.

‡ Berl. ent. Zeits., v, 1861, pp. 253–306, pl. ii.

§ Wien. ent. Zeit., xxxiii, April 1914, pp. 73–98.

|| Bull. Soc. ent. ital., xxxix (1907), 1908, pp. 3–199 (v. pp. 138–142).

¶ Boll. Lab. Zool. Portici, v, September 1910, pp. 1–32, 11 figs.

may be added as a fourth the somewhat aberrant SCHISTOPTERINAE. All these four subfamilies are well represented in the Ethiopian fauna, while the first and the last are very scarce or even absolutely wanting in America.

* * * *

Owing to the great importance of chaetotaxy for the distinction of these flies, in the following tables and descriptions abbreviations are used for indicating the bristles or macrochaetae, as follows:—

a. sa. = anterior supra-alar.	prsc. = praescutellar.
a. sct. = apical scutellar.	prst. = praesutural.
b. sct. = basal scutellar.	p. sa. = posterior supra-alar.
dc. = dorso-central.	pt. = pteropleural.
hm. = humeral.	pvt. = postvertical.
i. or. = inferior orbital.	sa. = supra-alar.
mpl. = mesopleural.	scp. = scapular.
npl. = notopleural.	sct. = scutellar.
oc. = ocellar.	st. = sternopleural.
ocp. = occipital row.	s. or. = superior orbital.
or. = orbital.	vt. = vertical.

* * * *

The Ethiopian genera of TRYPAEIDAE may be distinguished as follows:—

- 1(6). Thoracic chaetotaxy incomplete, hm., prst., dc. and st. being always wanting (and also the prsc. in African forms)... .. Subfam. DACINAE.
- 2(5). Femora not spinose beneath; thoracic suture interrupted; inferior angle of the anal cell drawn out into a very long, thin point.
- 3(4). Only two sa. present, the anterior one being entirely wanting
Dacus, F. (*s. str.*).
- 4(3). Three sa., the anterior one being well developed... .. *Tridacus*, Bezzi.
- 5(2). Femora spinose beneath; thoracic suture complete; point of anal cell proportionally short *Meracanthomyia*, Hend.
- 6(1). Thoracic chaetotaxy complete; that is, the above-named bristles usually present, or at least not all wanting at the same time.
- 7(92). Wings with the costa not broadly interrupted at end of the auxiliary vein, and destitute of peculiarly coloured "bullae" on the disc.
- 8(67). Ocp. composed of thin and acute bristles, which usually are of a black colour; in doubtful cases, either the antennal arista is plumose, or the scp. are well developed, or the dc. are placed much behind the suture, or the third longitudinal vein is bristly, or the point of the anal cell is long, or the wings are not reticulate, or the body shows a striking coloration
Subfam. CERATITINAE.
- 9(10). Femora spinose beneath; arista shortly plumose; third longitudinal vein with only a few bristles near its extreme base .. *Conradtina*, End., p. 222.
- 10(9). Femora not spinose beneath.

- 11(48). Third longitudinal vein bristly throughout its whole length, or at least from the base to the small cross-vein; ocp. mostly black; arista very often pilose or plumose; scp. well developed; lower angle of the anal cell mostly drawn out in a point which is longer than the second basal cell.
- 12(29). Dc. placed only a little behind the connecting line between the a. sa., and thus not very far from the suture.
- 13(16). Three strong i. or. present; hind cross-vein placed obliquely outwards, that is, with its upper end more distant from the base of wing than the inferior one; upper angle of discoidal cell therefore acute; occiput with lateral swellings below; eyes narrow.
- 14(15). Body prevalently black, with striking yellow or white markings; wings with the discoidal cell short and broad, adorned with blackish longitudinal bands and with a Λ -shaped band near the hind border
Carpophthoromyia, Aust., p. 224.
- 15(14). Body prevalently yellowish; wings with the discoidal cell more elongate and only with some yellowish, partly infuscated, transverse bands
Leucotaeniella, gen. nov., p. 227.
- 16(13). Only two i. or. present; hind cross-vein inwardly oblique, its lower end being more remote from the wing base than the upper one; the acute angle of the discoidal cell is therefore the lower one.
- 17(28). Middle scp. well developed; legs short and stout; wings of broader shape; head not "balanced" (see p. 241), with rather rounded eyes and less developed lower occipital swellings.
- 18(19). Third antennal joint distinctly pointed at the upper end; arista long plumose; lower occipital swellings rather developed.
Chelyophora, Rond., p. 229.
- 19(18). Third antennal joint rounded at end.
- 20(27). Basal segment of the costa destitute of bristles before the costal bristle.
- 21(26). Head, in side view, less shortened, the eyes being therefore more rounded; thorax and scutellum prevalently yellowish or reddish, with black spots; wings with yellowish bands and blackish basal streaks, the band passing over the hind cross-vein not united with the basal one.
- 22(23). Arista with short pubescence, more distinct on the upper side; frons of the male with conspicuous spatulate appendages
Ceratitis, MacLeay (*s. str.*), p. 230.
- 23(22). Arista with longer pubescence on both sides or shortly plumose; frons of the male without such appendages.
- 24(25). Middle legs of male broadly feathered, at least on the tibiae
Pterandrus, gen. nov., p. 231.
- 25(24). Middle legs of male simple *Pardalaspis*, gen. nov., p. 233.
- 26(21). Head distinctly shortened in side view, the eyes being more narrow; thorax and scutellum shining black, sometimes with white markings; wings with blackish bands radiating from the base, which is destitute of streaks; arista long plumose *Trirhithrum*, gen. nov., p. 236.

- 27(20). Basal segment of the costa provided with two groups of strong spines before the costal bristle *Bistrispinaria*, Speis.
- 28(17). No distinct middle sep.; legs long and slender; wings long and narrow, with the small cross-vein much before the middle of the discoidal cell and adorned with yellowish longitudinal rays; head "balanced," with narrow eyes and strongly developed lower occipital swellings
Xanthorrhachista, Hend., p. 241.
- 29(12). Dc. placed much behind the line of the a. sa., and therefore very far from the suture; eyes usually rounded; lower occipital swellings absent or less developed; hind cross-vein outwardly oblique.
- 30(33). Second longitudinal vein distinctly wavy; scutellum with three pairs of bristles, the intermediate pair being however often much smaller than the others; arista usually plumose or pilose.
- 31(32). St. wanting; head much broader than the thorax; middle scutellar bristles weaker; 3rd and 4th longitudinal veins with their last portions parallel *Themarictera*, Hend., p. 243.
- 32(31). St. present; head not or a little broader than the thorax; middle scutellar bristle as strong as the others; the above-named veins diverging distally; arista plumose or pubescent *Themara*, Walk., p. 244.
- 33(30). Second longitudinal vein straight.
- 34(37). Scutellum with three pairs of bristles; third longitudinal vein with numerous and very long bristles on its whole length.
- 35(36). Head normal, with rounded eyes; i. or. present; antennae separated by a keel from the base; lower angle of the anal cell drawn out in a long point *Baryglossa*, gen. nov., p. 244.
- 36(35). Head abnormal, with very narrow eyes; i. or. wanting; no keel between the antennae; anal cell not produced below *Cladoderris*, Bezzi, p. 246.
- 37(34). Scutellum with only two pairs of bristles.
- 38(39). Arista plumose; oc. rudimentary or wanting; wings mostly black
Ptiloniola, Hend., p. 246.
- 39(38). Arista bare or shortly pubescent.
- 40(41). Face very concave, without a distinct middle keel, but with prominent sides; abdomen long and thin, rather conical
Coelopacidia, End., p. 248.
- 41(40). Face of usual shape, with more or less distinct middle keel; abdomen ovate, not conical.
- 42(43). No prst. and no oc.; wings with the small cross-vein placed near the middle of the discoidal cell and with the last portion of the 4th longitudinal vein curved and diverging from the 3rd
Rhacochlaena, Loew, p. 248.
- 43(42). Prst. always present; oc. usually well developed; last portion of 4th vein not or less curved and not or little diverging.
- 44(45). Small cross-vein near or before the middle of the discoidal cell; wings adorned with narrow, vertical, fuscous bands, which are often partly broken into spots *Phorellia*, R.D., p. 249.

- 45(44). Small cross-vein much beyond the middle of the discoidal cell ; wings with a much more extended dark pattern.
- 46(47). Wings of usual shape and rather broad, with short stigma and distinct costal bristle, and with the fore half variegated ; oc. well developed
Philophylla, Rond., p. 249.
- 47(46). Wings rather narrow, with parallel sides, with elongate stigma and no costal bristle, and with the fore half usually entirely infuscated ; oc. very thin or even wanting *Ocneros*, O. Costa, p. 250.
- 48(11). Third longitudinal vein quite bare or only with a few bristles near the base ; ocp. mostly pale ; arista usually bare or shortly pubescent ; sep. sometimes less developed ; anal cell usually with a short point.
- 49(50). Dc. much behind the line of the a. sa. ; wings narrow and long, with parallel sides ; anal cell with a long point *Ocnerioxa*, Speis.
- 50(49). Dc. on the line of the a. sa. or only a little behind ; wings of usual shape.
- 51(52). Anal cell quite rounded outwardly, its lower angle being neither acute nor produced *Tephritis*, Latr.
- 52(51). Anal cell with the lower angle acute, and more or less produced in a short point.
- 53(54). Prst. wanting ; oc. very little developed ; arista shortly plumose ; body pale-coloured *Staurella*, Bezzi.
- 54(53). Prst. always present ; arista bare or shortly pubescent.
- 55(60). Body mostly pale-coloured, often with black spots on thorax and scutellum ; sep. always pale ; wings with yellowish bands or rays, or quite hyaline.
- 56(57). No oc. ; small cross-vein at or before the middle of the discoidal cell
Carpomyia, A. Costa,
- 57(56). Oc. well developed ; small cross-vein beyond the middle of the discoidal cell.
- 58(59). Eyes narrow, much higher than broad ; prsc. as widely separated as the dc. ; wings with yellowish longitudinal rays *Craspedoxantha*, Bezzi.
- 59(58). Eyes rounded ; prsc. nearer together than the dc. ; wings with cross bands or wholly hyaline *Terellia*, R.D.
- 60(55). Body quite black, at the most only the abdomen reddish ; wings dark brown or blackish, with hyaline spots and indentations.
- 61(64). Thorax shining black, the ground-colour of back not or little altered by the faint greyish pollen ; scutellum convex, shorter than broad.
- 62(63). Three i. or. ; ocp. blackish or pale ; a. set. wanting or rudimentary, much shorter than the very long b. set. *Aciura*, R.D.
- 63(62). Only two i. or. ; a. set. about as strong as the b. set. ; ocp. quite black
Spheniscomyia, Bezzi.
- 64(61). Thorax on the back densely clothed with greyish pollen, the ground-colour not or hardly visible ; scutellum flat, as long as broad, usually with strong a. set.
- 65(66). Wings of usual shape, with an *Aciura*-like pattern, without hyaline spots on the disc *Tephrella*, Bezzi.

- 66(65). Wings more or less widened, rounded at end and narrow at base with some hyaline spots in the middle *Platensina*, End.
- 67(8). Ocp. composed of strong and usually obtuse bristles, which are pale yellowish or whitish in colour, at least in part; sep. mostly not or less distinct; third longitudinal vein bare on the upper side, or exceptionally with a few bristles near the base; in doubtful cases, either the wings have a reticulate pattern, or the dc. are placed much before the a. sa., or the lower point of anal cell is very short, or the arista is bare, or the coloration of body is much more modest, and entirely without striking markings.
Subfam. TRYPANEINAE.
- 68(69). Wings with *Aciura*-like pattern, that is, with two hyaline indentations at fore border and three or four at hind border; a. sct. present or absent *Tephrella*, Bezzi (*p. p.*).
- 69(68). Wings with a different pattern.
- 70(73). Wings much widened and rounded outwardly, about as long as broad, with the 2nd and 3rd longitudinal veins much diverging distally; arista shortly plumose or with rather long pubescence.
- 71(72). Face and frons without black spots; axillary cell very narrow, narrower than the marginal one; wings with a few hyaline discal spots
Platensina, End.
- 72(71). Fore part of the frons or face with velvety black spots; axillary cell well developed; wings with numerous and usually minute hyaline spots on the disc *Eutretosoma*, Hend.
- 73(70). Wings of usual shape, not or but little widened, at any rate much longer than broad; arista bare or microscopically pubescent.
- 74(75). Wings very narrow and long, with parallel sides and with the anal cell obtuse, its lower angle not being acute.. .. . *Elaphromyia*, Big.
- 75(74). Wings not so shaped, and with the lower angle of anal cell mostly acute.
- 76(81). Wings with the black pattern more extended than the hyaline one; hyaline discal spots very few in number, thus the wings not appearing reticulate.
- 77(80). Wing pattern not distinctly radiating at apex and hind border.
- 78(79). Two i. or.; proboscis long and rather geniculate; b. sct. very long, the a. sct. wanting or rudimentary *Spathulina*, Rond.
- 79(78). Three i. or.; a. sct. well developed; proboscis short and simple
Pliomelaena, subgen. nov.
- 80(77). Wing pattern distinctly radiating; proboscis not geniculate; usually two i. or. and four equal sct. *Euaresta*, Loew.
- 81(76). Wings with the hyaline part more extended than the blackish one, or appearing reticulate owing to the numerous discal spots, or being dimidiate, or having a star-shaped apical pattern.
- 82(83). Head depressed, considerably longer than high, with very narrow jowls; if head not so depressed, the proboscis very long and geniculate, its terminal part being as long as or longer than the lower border of head
Ensina, R.D.

- 83(82). Head not depressed and proboscis usually short and simple ; if the proboscis is geniculate, its terminal part is shorter than the basal one.
- 84(89). Wings with a properly reticulate pattern, extended over all, or almost all, their surface.
- 85(88). Frons flat, and not at all or little produced above ; ovipositor flat.
- 86(87). Frons of usual breadth ; antennae rather approximate ; wings not at all widened, with the stigma unicolorous or with a single hyaline spot
Euribia, Meig.
- 87(86). Frons very broad ; antennae broadly separated ; wings distinctly widened, usually with short, radiating, marginal streaks and with a bimaculate stigma
Campiglossa, Rond.
- 88(85). Frons convex and prominent above ; ovipositor conical
Camaromyia, Hend.
- 89(84). Wing pattern not extended over the greater part of surface, but either the hind or the basal half is quite hyaline.
- 90(91). Wings dimidiate, that is, on the fore half with a dark reticulation, at least at the end, on the hind half either quite hyaline or with a very faint reticulation.. .. .
Acanthiophilus, Beck.
- 91(90). Wings with a star-shaped pattern on the terminal half *Trypanea*, Schrank.
- 92(7). Wings with the costa broadly interrupted at end of the auxiliary vein, and there with a projecting border ; they are provided with strikingly distinct "bullae" ; ocp. thick and yellowish ; arista bare or shortly pubescent ; dc. near the suture ; 3rd longitudinal vein bare, small cross-vein often obliterated ; anal cell obtuse or acute below, but not prolonged (subfam. SCHISTOPTERINAE).
- 93(94). Second longitudinal vein long, ending at costa nearer to the end of the third ; anal cell acute below ; 3rd and 4th longitudinal veins not or but little diverging distally
Rhabdochaeta, de Meij.
- 94(93). Second longitudinal vein short, ending at costa nearer to the first ; anal cell obtuse below ; 3rd and 4th longitudinal veins exceedingly divergent outwardly.
- 95(96). Scutellum with 6 bristles ; 3rd longitudinal vein ending before the apex of wing.. .. .
Rhockmopterum, Speis.
- 96(95). Scutellum with 4 bristles ; 3rd longitudinal vein ending at apex
Schistopterum, Beck.

I. Subfam. DACINAE.

The Ethiopian species of this subfamily have been dealt ~~out~~ by me in two previous papers, published in this Bulletin.*

Of the Oriental genus *Meracanthomyia* there is a species, *antennata*, Hendel (Wien. ent. Zeit., xxxi, 1912, p. 11), described from W. Africa, Ashanti.

* Bull. Ent. Res., vi., September 1915, pp. 85-101, 14 figs.; viii, August 1917, pp. 63-71, 6 figs.

II. Subfam. CERATITINAE.

Of this numerous subfamily only the genera with a bristly third longitudinal vein are treated in the present paper.

I. CONRADTINA, Enderlein, 1911.

This well characterised genus has a rather isolated position, and comprises some species of greater size which are not unlike the Oriental species of *Lagarosia*, in which however the femora are unarmed. The genus *Celidodacus*, Hendel, 1914, with its undescribed type-species, *C. apicalis*, Hendel, from South Nigeria (Wien. entom. Zeit., xxxiii, April 1914, p. 75), is not dealt with here, as I have been unable to recognise it, but the new species here described (*Conr. suspensa*) apparently has a very similar wing pattern.

To the characters of the genus *Conradtina* may be added that the second longitudinal vein is distinctly sinuous, and that the first is very short, ending much before the small cross-vein, which is placed beyond the middle of the discoidal cell. The genus, as far as at present known, is confined to West Africa. The species can be distinguished as follows:—

- 1(6). Apex of wing at end of 3rd and 4th longitudinal vein more or less broadly whitish hyaline, the apical fuscous band being therefore not contiguous with the wing border.
- 2(5). The two fuscous bands on the two cross-veins separated in the middle.
- 3(4). The two above-named bands separated at the hind border; apical hyaline band rather broad *acroleuca*, Wied.
- 4(3). These two bands coalescent at the hind border; apical hyaline band very narrow; a fuscous oblique streak across the middle of the last portion of 4th vein *acrodiauges*, Speis.
- 5(2). The two fuscous bands united to form a single broad patch, which is attached by a brown streak to the fore border *suspensa*, sp. nov.
- 6(1). Apical fuscous band contiguous to the costa, and thus entirely filling the wing tip; an oblique fuscous streak on the middle of the last portion of 4th vein *longicornis*, End.

1. **Conradtina longicornis**, Enderlein, Zool. Jahrb., xxxi, 1911, p. 443, fig. S.

Described from W. Africa, Fernando Po.

2. **Conradtina acrodiauges**, Speiser, Deut. ent. Zeits., 1913, p. 145.

Of this species, described from Camerun, Duala, I have before me the specimen collected at Lagos, S. Nigeria, by Prof. F. Silvestri and recorded by me in 1914.*

3. **Conradtina acroleuca**, Wiedemann, Auss. zweif. Ins., ii, 1830, p. 520 (*Dacus*).

Prof. Hendel in 1912† has redescribed this species from W. Africa, Sierra Leone; Wiedemann's type was from an unknown locality.

* Boll. d. Labor. di Zool. gen. e agr. Portici, viii, May 1914, p. 303.

† Wien. entom. Zeit., xxxi, February 1912, p. 13.

4. *Conradtina suspensa*, sp. nov. (fig. 1).

Very distinct from all the other known species on account of the broad fuscous patch on the middle of wings, comprising in a single spot both the cross-veins, as in *Lagarosia*.

♀. Length of body (with the ovipositor), 10 mm. ; of wing, 8 mm.

Head reddish yellow, with a broad black patch on each side of the occiput, which shows no distinct lateral swellings. Frons with a dark stripe on each side, which is shining and prominent on the basal half ; the face and the rather narrow jowls are without dark spots. Antennae wholly yellowish, the third joint rounded at tip and a little longer than the face ; arista rather long plumose, the feathering being broader than the breadth of the third antennal joint. Palpi and proboscis dirty yellowish. The cephalic bristles seem to be all of a black colour, but they are in part broken off. Thorax black on the back, with a faint pale pubescence ; humeri pale yellowish ; the sides of back near the suture and on the hind half are partly of a dark reddish colour ; pleurae black, shining, but the whole sternopleura is yellowish. Scutellum triangular, flat above, pale yellowish on the sides and



Fig. 1. Wing of *Conradtina suspensa*, sp. nov.

below, much darker reddish in the middle ; it bears four bristles. All the bristles are black ; sc. long and strong. Mesophragma entirely black, rather shining. Halteres pale yellow. Abdomen quite black, even on the venter ; ovipositor black, flat, as long as the last two abdominal segments. Legs with all the coxae and the anterior and posterior femora pale yellow ; middle femora mostly dark brown ; all the tibiae dark brown or even blackish, with the tips narrowly reddish ; middle tarsi quite black, the others reddish at base. All the femora are armed on the apical half with two rows of short but strong, black spines, 3-4 in each row. Wings (fig. 1) with the normal venation ; the 3rd longitudinal vein is provided with 3-4 bristles only at its extreme base. They are whitish-hyaline, with three fuscous bands, disposed as follows : The first is narrow and extends perpendicularly from the stigma to the end of the anal cell. The second is very broad, shaped as a rounded spot extending from the 3rd vein to the hind border, enclosing the two cross-veins, and joined by a short peduncle to the apical band. This last, or the third, is narrow and regularly curved ; after the end of the 2nd vein it is removed from the costa, which is again reached at the end of the 4th, thus

forming a hyaline band, which is as broad as the fuscous band itself. This apical hyaline part is distinctly whitish. There is no trace of a dark streak across the middle of the last portion of the 4th vein.

Type ♀, a single, rather old specimen from the Congo, in the writer's collection.

II. CARPOPHTHOROMYIA, Austen, 1910.

This genus was erected by Austen* on the type-species *vittata*, Fabricius and Loew, uniting with it also *grata*, Wiedemann and Loew, *scutellata* and *tritea*, Walker, and the two new species *formosula* and *pulchella*; it was distinguished from *Ceratitis* by its general facies, the flat and triangular scutellum and the tubular ovipositor. In 1913† I took it as the 5th section of *Ceratitis*, thus adding to it the species which are now placed in the new genus *Trirhithrum*. In 1914‡ Hendel (who at first§ had accepted it in the foregoing sense) restricted it to the two species *scutellata* and *tritea*, with the main characters of the colour of body, number of i. or., pattern of wings and shape of the cross-veins.

I have followed here these views of Hendel, but including in the genus also the type species *vittata*, which has the hind cross-vein not *Ceratitis*-like and has not even a typical wing pattern. If this species is not congeneric with the others, the name *Carpophthoromyia* must be used exclusively for it, and a new generic name is necessary for *scutellata* and *tritea*. The genus seems to be an exclusively Ethiopian one; Prof. de Meijere has recently (1914) described a *C. tomentosa* from Java, which however seems to belong to *Carpophthorella*, Hendel. For the three species *grata*, *formosula* and *pulchella*, which all agree in wing pattern and have a *Ceratitis*-like hind cross-vein, but have all a flat scutellum, a new genus is necessary; but I have not yet seen these species in nature.

The species provisionally placed here can be distinguished as follows:—

- 1(8). Second longitudinal vein rather straight; base of wing wholly infuscated, without streaks; scutellum flat above and white or pale yellow in colour; abdomen destitute of whitish transverse bands.
- 2(3). Wings without hyaline indentations at fore border and with the Λ -shaped band united with the fuscous of the base in the 3rd posterior cell; scutellum with brown tip *vittata*, Fabr.
- 3(2). Wings at fore border with a broad triangular hyaline indentation near the stigma; the inner branch of the Λ -shaped band is separated from the fuscous of the base.
- 4(5). Scutellum entirely yellow; abdomen ferruginous towards the base; femora tawny; costal cell partly hyaline *scutellata*, Walk.
- 5(4). Scutellum on its posterior margin with three black spots, which are not visible from above; abdomen entirely black; femora mostly black; costal cell wholly infuscated.

* Bull. Ent. Res., i, April 1910, p. 71.

† Boll. Lab. Zool. gen. agr. Portici, vii, February 1913, p. 22.

‡ Wien. ent. Zeit., xxxiii, April 1914, pp. 80 and 97.

§ Wien. ent. Zeit., xxxi, February 1912, p. 15.

- 6(7). Frons with a transverse brown stripe; humeral calli dark brown; white mesopleural patch vertical; front femora entirely black .. *tritea*, Walk.
- 7(6). Frons with a longitudinal brown stripe; humeral calli white; mesopleural patch longitudinal; front femora whitish at apex *pseudotrítea*, sp. nov.
- 8(1). Second longitudinal vein distinctly wavy; wings with basal streaks; scutellum rather convex and shining black; abdomen with two broad transverse bands of whitish pollen.. .. *superba*, sp. nov.

1. ***Carpophthoromyia vittata***, Fabricius, Wiedemann; Loew, Berl. ent. Zeits., v, 1861, p. 262, pl. ii, fig. 3.

Originally described from Guinea, Loew has it from Senegal, and Austen records it from East Africa, Delagoa Bay, and from Natal, Malvern.

2. ***Carpophthoromyia scutellata***, Walker, Ins. Saund., iv, 1853, p. 384, pl. viii, fig. 5. Described with a query from Senegal, and recorded by Austen from Sierra Leone.

3. ***Carpophthoromyia trítea*** Walker, 1849; Austen, Bull. Ent. Res., i, 1910, pp. 72 & 76. Described from Sierra Leone, and not found subsequently.

4. ***Carpophthoromyia pseudotrítea***, sp. nov. (Plate v, fig. 1).

Ceratitis trítea, Bezzi, Bull. Lab. Zool. Portici, vii, 1913, p. 25, fig. 2; Silvestri, l.c., viii, 1913, p. 69, fig. 14.

Closely allied to the preceding species, but easily distinguished by the characters given in the table.

♂ ♀. Length of body, 5–6 mm.; of ovipositor, 1 mm.; of wing, 5–6 mm.

In my previous papers I have referred the present species to *trítea*, Walker, with a doubt, owing to the character of the dark brown humeral calli as indicated by Mr. Austen. I have never seen the true *trítea*.

Now Dr. G. A. K. Marshall has compared the present specimens with the type in the British Museum, and has found that they belong to a distinct species. It differs in having the frons pale yellowish, with a brown longitudinal stripe, instead of being pale brownish on the upper half and whitish on the lower half, thus forming a transverse band. Besides, the humeral calli are white (not dark brown), and the white mesopleural patch is longitudinal (not vertical) and twice as long as deep. The front femora are whitish at the apex and the four posterior tibiae are entirely whitish (not brownish on the basal half). The hyaline indentation after the stigma on fore border of the wings is much shorter, ending a little beyond the 3rd longitudinal vein, instead of being continued backwards into the base of the 3rd posterior cell.

Type ♂ from Gold Coast, Aburi, 1912–13 (*W. H. Patterson*); type ♀ from Aburi, April–May 1911 (*L. Armstrong*); and some additional specimens from South Nigeria, Agege, 17th April 1914 (*Dr. W. A. Lamborn*). I have seen the specimens collected in South Nigeria, Olokemeji, by Prof. Silvestri, bred from fruits of *Pyrenacantha vogeliana*.

5. **Carpophthoromyia superba**, sp. nov. (Plate v, fig. 2).

A strikingly distinct species, which is provisionally placed in the present genus, notwithstanding the different shape of the scutellum and the basal streaks of the wings. It much resembles the Oriental genus *Anaplopus* in general appearance and wing pattern, but has a strong hm.

♀. Length of body, 5.5 mm.; of ovipositor,* 2 mm.; of wing, 6 mm.

Head pale yellowish, with a broad, reddish-brown stripe on middle of the frons; occiput with a brown spot above on each side, and with well developed, white and whitish pilose, lower lateral swellings. Eyes narrow, higher than broad, acute below. Face rather narrow and long, entirely whitish; a broad, reddish brown spot below the lower angle of eyes. Palpi whitish, broadly ovate, with short black bristles; proboscis black. The antennae are wanting in the type; there are only the basal joints, which are reddish. All the bristles of the head are black; there are three strong i. or.; the oc. are long but thin; the ocp. strong and black. Thorax on the back entirely shining black, with sparse and short whitish pubescence; the humeral calli and the notopleural depression are of a very dark reddish-brown colour; on the pleura there is a broad, oblique, white stripe, which occupies almost the whole of the meso- and ptero-pleura; sternopleura entirely reddish-brown; there are two united white hypopleural spots. Scutellum entirely shining black; it is convex and rounded; only at the extreme base of the sides there is a very small, dark yellowish spot. Postscutellum and mesophragma shining black. Chaetotaxy complete; all the bristles black; dc. placed on the line of the a. sa.; 2 strong mpl.; 4 set. Halteres with whitish stalk and blackish knob. Abdomen shining black, ovate; with strong black bristles on the sides of last segment; first segment dark ferruginous at base, with a broad and complete band of white dust at hind border; the 2nd white band occupies more than the whole hinder half of the 3rd segment. The ovipositor is long, reddish, flat. Venter reddish brown, with pale dust. Legs and coxae pale reddish, the middle femora almost entirely black, the others broadly reddish at base; tibiae and tarsi whitish, the middle tibiae more darkened at base; front femora with 5-6 long, black bristles; middle tibiae with a very long and strong, black spur; hind tibiae with a short row. Wings broad and long. The extreme base is whitish hyaline; after this there is a portion extending to the stigma and to the base of the 3rd posterior cell, occupied by parallel, alternate, blackish and hyaline longitudinal streaks. The stigma is occupied by a triangular, hyaline indentation, extended below to the 3rd vein. There is an arcuate, blackish band, which extends obliquely from the anal veins, passing over the small cross-vein, to the fore border, and along this to over the end of the 3rd vein, including some darker spots along the costa and leaving a very narrow clear stripe along it. The Δ -shaped band of the hind border is regular, but is broken in the middle, just above the 4th vein. Costal spine long and strong; 2nd longitudinal vein distinctly wavy; hind cross-vein oblique outwardly, 1st posterior cell very broad; small cross-vein a little beyond the middle of the short and broad discoidal cell; anal cross-vein very bent

* By ovipositor (and its length) is always meant what is in reality the 7th abdominal segment of the female. This is so called by authors and is always intended for *basal segment*; the true ovipositor is the *apical segment*, which is mostly retracted, and thus only rarely recorded by authors in their descriptions.

in the middle; inferior angle of anal cell not surpassing in length the second basal cell; discoidal cell only about twice as long as the hind cross-vein.

Type ♀, a single specimen (British Museum) from Nyasaland, Limbe, Chiromo, Ruw R., 22 September 1916 (*R. C. Wood*).

Note.—The three species, provisionally placed here, which require the formation of a new genus, are:—

- (a) *grata*, Wiedemann; Loew, Berl. ent. Zeits., v, 1863, pl. ii, fig. 6; from Cape of Good Hope.
- (b) *pulchella*, Austen, Bull. Ent. Res., i, 1910, p. 72, fig. 1; from Uganda, Entebbe, and recorded from Camerun by Dr. Speiser in 1915.
- (c) *formosula*, Austen, Bull. Ent. Res., i, 1910, p. 74, fig. 2; from Uganda.

III. LEUCOTAENIELLA, gen. nov.

The present new genus seems to be allied to the Oriental *Taeniostola*, from which it differs in having 3 i. or., no black stripes on the thorax, abdomen with whitish instead of black bands, and different wing pattern. Head in front view as broad as high; eyes much higher than broad, very narrow; occipital lower swellings much developed; jowls rather broad. Antennae inserted at the middle of the eyes, short, with the third joint rounded at tip and reaching only the middle of the face; arista long plumose. Cephalic bristles long and strong, black; 2 s. or. and 3 i. or., the latter very strong; 2 vt., the inner more than twice as long as the outer; ocp. well developed, black; oc. strong and long; genal bristle strong. Thoracic chaetotaxy complete; scp. much developed, the inner ones closely approximate; dc. placed only a little behind the line of the a. sa.; 2 mpl.; pt. long and strong. Scutellum rather convex above, but less than in *Ceratitis*, black-spotted, with 4 bristles. Abdomen ovate, bristly on the sides and at end; male genitalia small; ovipositor broad, flat, as long as the last three abdominal segments. Legs stout; front femora with a complete row of bristles; middle tibiae with a single spur; row of bristles on hind tibiae short, developed only about the middle. Wings broad, shaped and patterned as in *Ceratitis*, but without basal streaks; the bands are yellowish, partly infuscated at the borders. Costal bristle long and strong; 1st longitudinal vein ending before the small cross-vein; 2nd quite straight; 3rd a little curved about the middle, and then parallel with the last portion of the 4th, with bristles on its whole length; small crcss-vein placed a little beyond the middle of the discoidal cell; posterior cross-vein long, outwardly oblique; discoidal cell long, about 2·5–3 times as long as the hind cross-vein; anal cross-vein deeply sinuous, the anal cell with a rather broad point, which is not longer or even a little shorter than the second basal cell.

Type: the first of the two following new species, which may be distinguished as follows:—

- 1(2). Scutellum with a single black spot, the apical one (not counting the spots on the postalar calli, which are present in both species); wing bands broader, the basal one almost complete *trispila*, sp. nov.
- 2(1). Scutellum with three black spots; wing bands narrower, the basal one less distinct *pentaspila*, sp. nov.

The possibility is not excluded that the above recorded *Trypeta grata* under *Carpophthoromyia*), notwithstanding the much darker coloration of the body, may belong to the present new genus, as suggested by the very similar shape of the head and of the wing pattern.

1. **Leucotaeniella trispila**, sp. nov. (Plate v, fig. 3).

A very distinct, pale-coloured species, with yellowish banded wings and with three very striking black spots on the postalar calli and scutellum.

♂♀. Length of body, 5.5–6 mm.; of ovipositor, 1 mm.; of wing, 5.5–6 mm.

Head entirely yellowish, without any dark spot, only the small ocellar dot being black; the lower occipital swellings, the face and the jowls whitish; all the bristles black; the hairs on occiput whitish. In the middle of the frontal stripe there is a less distinct, dark reddish, semicircular spot. Antennae entirely yellow, even the arista. Palpi whitish, with pale hairs and a few short black bristles at end; proboscis dirty yellowish. Thorax entirely reddish yellow; on the back there is pale pubescence and whitish dust, which forms three very indistinct darker longitudinal stripes; the humeral calli, a broad, oblique mesopleural stripe and two contiguous hypopleural spots are whitish or white; pleurae and mesophragma reddish, like the back; behind the suture, there is on the back a pale yellowish stripe on each side. On the postalar calli, just near the extreme base of scutellum, there is on each side a deep black, opaque, rounded spot. Scutellum shining pale yellowish; its single apical spot is subquadrate, less visible from above, filling out the space below and between the apical pair of bristles; it is shining black. All the bristles are black; pleurae with whitish hairs. Halteres whitish, with the base of stalk yellowish. Abdomen entirely reddish above, paler below, with pale hairs and black bristles; the transverse bands of whitish dust are on hind borders of first and almost on whole of 3rd segment; in the female there is a band also on the 4th segment. Male genitalia shining black, with yellow base; ovipositor entirely reddish, darker at the end. Legs and coxae entirely and uniformly pale yellowish; all the bristles black. Wings hyaline, with yellowish veins and the following yellowish pattern, margined with brown along the sides of the bands on the hind half: A basal band, going obliquely from the stigma to the end of the anal cell; the stigma is yellowish, with a dark brown, rounded spot near its base; the costal cell is hyaline in the middle, the second basal cell is yellow. An oblique band beginning after the stigma and separated from this, going over the small cross-vein to the middle of the last portion of anal vein. From this band runs a marginal stripe, which going along the fore border ends with a brown patch in the middle between the ends of the third and 4th longitudinal veins; along the costa this band encloses 3–4 small hyaline spots, partly bordered with fuscous. From the middle of this band runs an oblique streak, which, passing across the middle of the last portion of the 4th vein, reaches the hind border a little below the end of this last vein. Finally there is a broad edging to the hind cross-vein, which is widened and more infuscated near the hind border, and ends above in a point near the 3rd longitudinal vein.

Type ♂ and type ♀ (British Museum), a single pair of specimens from Nyasaland, Limbe, Chiromo, Ruw R., 22nd September 1916 (*R. C. Wood*).

2. *Leucotaeniella pentaspila*, sp. nov.

Closely allied to the preceding species, but at once distinguished on account of its three scutellar black spots and of the somewhat different wing pattern.

♀. Length of body, about 5 mm. ; of ovipositor, 1 mm. ; of wing, 5 mm.

Head wanting in case of type. Thorax as in the preceding, but there is no trace of the yellow lateral stripes, and behind the suture there is a faint, blackish pattern of a triangular shape; the whitish markings are as in the preceding species, and likewise the deep black spots on the postalar calli. Scutellum with the apical spot, and besides with a rounded spot on each side, just behind the root of the b. set. ; these spots are partly visible from above. Mesophragma dark brown, blackish below, and with a black patch beneath the double hypopleural spot. Halteres whitish. Abdomen as in the preceding species, with three broad, whitish, transverse bands ; ovipositor similarly reddish. Legs entirely pale yellowish. Wings with the basal band less distinct, almost divided into spots, the basal cells being almost entirely hyaline, with only a few dark streaks at the end ; costal cell hyaline, with only a dark spot on each end ; stigma hyaline, with a rounded, blackish, basal spot. The oblique 2nd band is as in the preceding species, but narrower and uniformly darkened. The fore border is rather broad, but shows no distinct clear spots along the costa and is uniformly darkened ; the oblique streak running from it is narrower and at the base rather separated from it. The incomplete band on the hind cross-vein is narrow, and above does not extend into the first posterior cell, or only slightly so. The neurulation is identical with that of the preceding species.

Type ♀ (British Museum), a single specimen without a head, from Anglo-Egyptian Sudan (*H. H. King*).

IV. CHELYOPHORA, Rondani, 1875.

As stated by Prof. Hendel, after examination of the type, this genus is coincident with my own genus *Stictaspis*, 1913 ; it is however to be remarked that Rondani in his diagnosis says of the third antennal joint : “ *nec distincte concavo superne, nec apice mucronulato.* ”

1. *Chelyophora magniceps*, sp. nov.

Rather like *striata*, but distinguished by its shorter third antennal joint, only two i. or., different pattern of back and scutellum, and the fuscous band over the hind cross-vein being united with the basal one, instead of being united with the costal border.

♀. Length of body, 6 mm. ; of ovipositor, 2.5 mm. ; of wing, 6 mm.

Head less compressed, as broad as high, the frons therefore much broader than in *striata*. Occiput entirely yellowish, shining above, whitish and opaque on the rather developed lower swellings ; frons golden yellow, with faint sericeous reflexions ; ocellar spot reddish ; lunula and face whitish ; jowls very broad, with an indistinct dark reddish spot below the eye. The eyes are shorter, and proportionally less narrowed than in *striata*. Antennae entirely reddish, short, not reaching the middle of the face ; 3rd joint only twice as long as the 2nd, rather broad, with a sharp point on its upper terminal corner ; arista very long plumose. Palpi pale yellowish, with short black bristles ; proboscis reddish. All the cephalic

bristles are black; oc. long and strong; only two i. or., with a very thin and rudimentary one in front of the 2nd pair; pvt. long; genal bristle very strong. Back of thorax reddish, with yellowish pubescence; the black lateral spots are about as in *striata* and likewise shining above and velvety opaque below, but the middle longitudinal stripe is faintly indicated by a very narrow, dark brown line, and there is no black patch behind the suture; the pleurae are uniformly pale yellowish, immaculate; there is a double, whitish hypopleural spot; the mesophragma is shining reddish, and the postscutellum is black. The scutellum bears three very broad, shining black spots, the middle one extending above only to the middle of the disc, the lateral ones reaching the base; besides there is on each side a deep black, velvety opaque, rounded spot on the postalar calli, invading also the extreme sides of lateral margin of scutellum. Chaetotaxy complete, with strong and black bristles, the dc. are placed a little before the line of the a. sa.; scp. well developed; 2 mpl.; pt. very strong; 4 set. Halteres pale yellowish, with a darker knob. Abdomen elongate, reddish, with pale yellowish base; hind border of 1st and almost the whole of 3rd segment with broad, complete, transverse bands of whitish dust. Ovipositor long, reddish brown, with short black hairs. Sides and end of abdomen with long black bristles; venter yellowish, with whitish dust. Coxae and legs entirely pale yellowish, the tarsi being a little darkened at the end; bristles black: hind tibiae without distinct row. Wings with strong costal bristle and normal neuration; the hind cross-vein however, which is rather perpendicular in *striata*, is here oblique as in *Ceratitis*; small cross-vein a little beyond the middle of the discoidal cell. Base of wing to the end of the second basal cell with alternate blackish and hyaline streaks, one dark streak in each cell, beginning with the costal and ending with the anal cell; a short perpendicular yellowish band extending from base of stigma to the 5th vein; stigma hyaline, with narrow yellow base. The other bands are yellowish, infuscated towards the hind border and disposed in the usual radiating form of *Ceratitis*; the oblique band over the hind cross-vein is united with the basal band in front of the small cross-vein; the marginal band has three fuscous spots along the costa, where it is narrowly colourless; the subapical oblique streak is complete and well united to the costal band. Along the 5th longitudinal vein the basal complete band is narrowly united with that of the extreme base.

Type ♀ (British Museum), a single specimen from Anglo-Egyptian Sudan (*H. H. King*).

V. CERATITIS, MacLeay, 1829, *s. str.*

As here restricted, the present genus is confined to the type species *capitata*, Wied., from which *C. catoiri*, Guérin-Ménéville (Rev. Zool., vi, 1843, p. 197), is possibly distinct.* This latter species is recorded from the Island of Mauritius, and Froggatt in 1911 noted it from the Seychelles; *capitata* is known from the greater part of Africa.

* [*C. catoiri* is certainly distinct from *C. capitata*, being an obviously larger insect, almost equalling *C. rosa*, Karsch, in size. The oblique band over the hind cross-vein unites with the broad median band along the 4th longitudinal vein, and the apical section of this vein is crossed by an oblique fuscous spot. The stalk of the cephalic appendage in the male is much longer, the spatula being white in colour, and subtriangular, with the apex broadly truncate or slightly rounded; whereas in *C. capitata* the spatula is black and irregularly diamond-shaped.—Ed.]

VI. *PTERANDRUS*, gen. nov.

The present new genus is erected here for the 3rd section of *Ceratitis* in my paper of 1909.* It shows the complex of characters of the preceding genus, both structurally and ornamentally, but is very distinct in the male sex, which lacks the frontal appendages and has the middle legs feathered. The head is more compressed, and has the middle band of the frons less hairy; the arista has longer pubescence, even on the underside; the scutellum is similarly provided with stout, short hairs on the disc.

I have not succeeded in finding a distinction from the females of the following genus.

Type: *Ceratitis rosa*, Karsch, 1887.

The species of this exclusively Ethiopian genus may be distinguished as follows:—

- 1(6). Wings destitute of an oblique dark band across the last section of the 4th longitudinal vein.
- 2(5). Middle femora feathered beneath.
- 3(4). Middle tibiae broadly feathered; basal segment of the ovipositor short, measuring only 1 mm. in length *anona*, Grah.
- 4(3). Middle tibiae more shortly feathered; ovipositor twice as long *colae*, Silv.
- 5(2). Femora not at all feathered; ovipositor short *rosa*, Karsch.
- 6(1). Wings with a distinct oblique dark streak across the middle of last section of 4th vein.
- 7(8). Femora quite yellowish; thorax yellowish on the back and with less distinct pleural whitish band.. .. . *rubivorus*, Coquill.
- 8(7). The four posterior femora broadly black; thorax black on the back and with a distinct, white mesopleural stripe *volucris*, sp. nov.

1. ***Pterandrus anona***, Graham, 1908 (*pennipes*, Bezzi, 1908); Silvestri, Boll. Labor. Zool. Portici, viii, 1913, p. 61, fig. x.

Described from Ashanti and Congo, and recorded subsequently from South Nigeria.

2. ***Pterandrus colae***, Silvestri, Boll. Lab. Zool. Portici, viii, 1913, p. 63, fig. xi.

Described from Gold Coast, Aburi, and from Camerun, Victoria.

There are in the collection some specimens of both sexes from Gold Coast, Aburi, 1912–13 (*W. H. Patterson*) (Plate v, fig. 4).

3. ***Pterandrus rosa***, Karsch, Entom. Nachr., xiii, 1887, p. 22; Froggatt, Report 1909, p. 111.

Described from Delagoa Bay, and recorded from Natal.

I have received from Prof. Silvestri a pair of this species, caught at Durban, Natal, on 15th February 1917.

* Boll. Lab. Zool. gen. agr. Portici, iii, April 1909, p. 273–313, 4 figs. (see p. 277).

4. **Pterandrus rubivorus**, Coquillett, 1901 (*cosyra*, Fuller, 1900);* Silvestri, Boll. Lab. Zool. Portici, viii, 1913, p. 66, fig. xii.

Described from the Cape Colony; there is in the collection a ♀ specimen from Transvaal, Pretoria, 16th March 1914, in which the oblique streak on last portion of 4th vein is very faintly developed and hardly visible.

5. **Pterandrus volucris**, sp. nov.

Nearly allied to the preceding species, but at once distinguished by the broadly blackened legs.

♂. Length of body, 5 mm.; of wing, 5 mm. Occiput shining and yellowish above, with a blackish spot on each side, whitish opaque and with whitish hairs below. Frons dull yellowish, with a small and indistinct, dark spot on middle and with very sparse, short hairs; ocellar dot black; face pale yellowish; jowls narrow, immaculate. Antennae entirely pale yellowish; arista shortly plumose. Palpi and proboscis dirty yellowish. Cephalic bristles black; only two i. or. Thorax on back black, with greyish dust and short, yellowish pubescence; the sides and the hind half are shining; just before the scutellum there is a pale yellowish spot on each side. Pleurae dark brown, but the humeri and a broad mesopleural stripe are whitish. Pleurae with white hairs. All the bristles are black; dc. placed on the line of the a. sa.; a single mpl. Scutellum yellowish, with three very broad, rectangular, shining black spots and two very small basal ones; it bears 4 bristles, and short, pale yellowish hairs on the disc. Postscutellum shining black; mesophragma black, but with dense grey dust; a broad, double, whitish hypopleural spot. Halteres pale yellowish. Abdomen dark brown, with whitish pubescence and black bristles at the end; 1st and 3rd segment with a broad transverse band of whitish dust at hind border; genitalia shining yellow; venter brown, grey dusted. All the coxae pale yellow. Front legs wanting in type; middle and hind femora black, with yellow base; middle tibiae almost entirely black, hind tibiae pale yellowish with darkened base; all the tarsi are pale yellowish. Feathers of middle legs long but narrow, of an intense black colour; they are present on the last half of the underside of the femora, on the whole outer side and on the apical two-thirds of the inner side of the tibiae. The base of middle tibiae is clothed with argenteous tomentum. Wings hyaline, with scanty dark dots at base. First band narrow, extending from stigma across the small cross-vein to the end of the anal vein; the marginal band is separated from it, and shows the usual 5 dark dots. The oblique streak over the hind cross-vein is only a little produced above into the first posterior cell; the oblique streak across the middle of last portion of fourth vein is faint, but distinct. Venation normal; the small cross-vein is before the middle of the discoidal cell, which is narrow and long; stigma brown, with hyaline end; costal bristle short.

Type ♂ (British Museum), a single specimen from British E. Africa, Embu, 18th December 1913 (*G. St. J. Orde-Browne*).

*[Mr. C. P. Lounsbury informs us that, so far as he is aware, the true *Ceratitis rubivora*, Coq., has been bred only from blackberries in the Cape District (where it is quite common and attacks no other cultivated fruit) and is not conspecific with the Natal fruit-fly (*C. cosyra*, Fuller, nec Walk.), as erroneously stated by Froggatt. The specimens of the Natal fly sent us by Mr. Lounsbury are certainly referable to *C. rosa*, Karsch.—ED.]

It is very doubtful whether *Ceratitis penicillatus*, Bigot (Ann. Soc. Ent. France (7) i, 1891, p. 381; Froggatt, Report 1909, p. 108), from W. Africa, Assinia, belongs to the present genus.

VII. PARDALASPIS, gen. nov.

This new genus corresponds to the 4th section of *Ceratitis* on p. 277 of my above-quoted paper of 1909. It contains rather numerous species, which in the male sex are very easily recognizable by the simple frons and the simple middle legs. The wing pattern is mostly of a pale yellowish colour, but it is sometimes infuscated, and it varies from that of the type of *Ceratitis*, s. str., to that of *Pterandrus* (viz. with a separated costal band), and even to that of *Trirhithrum* (viz. with the middle band united to the marginal one).

Type: *Trypeta punctata*, Wiedemann, 1824.

The Ethiopian species may be distinguished as follows:—

- 1(16). Wings with the band over the hind cross-vein quite isolated.
- 2(13). The black spots of the scutellum are very broad, quadrate or rectangular, closely approximated, and covering almost the whole surface.
- 3(12). Last portion of the fourth longitudinal vein destitute of an oblique dark streak across its middle.
- 4(5). Wings broad, with strikingly developed basal streaks and dots and with the bands much infuscated; head of male with a peculiar and striking coloration *punctata*, Wied.
- 5(4). Wings with less developed basal pattern and with pale yellowish bands, which at most are infuscated only towards the hind border; head of male not peculiarly coloured.
- 6(7). Thorax destitute of black spots; species of greater size (8 mm.)
brêmei, Guér.
- 7(6). Thorax with distinct black spots, at least on the sides beyond the suture; size smaller (not over 7 mm.).
- 8(9). Humeri with a distinct black spot; sides of thorax with black spots before the suture; scutellum with basal black spots *giffardi*, Bezzi.
- 9(8). Humeri and sides of thorax before the suture destitute of black spots; scutellum with no distinct basal spots.
- 10(11). Arista pubescent; back of thorax whitish, with some small, deep black dots; wings with the marginal band united at stigma with the basal one
silvestrii, Bezzi.
- 11(10). Arista shortly plumose; thorax yellowish grey on the back, with broad, less distinct dark spots; marginal band isolated *morstatti*, Bezzi.
- 12(3). Last portion of 4th vein crossed over the middle by a well developed, oblique, dark streak; wings short and broad *antisticica*, Bezzi.
- 13(2). The black spots of the scutellum much smaller and broadly separated, the outer ones being more rounded; the scutellum therefore mostly yellow.
- 14(15). Scutellum with three black spots; wings with the marginal and the basal bands wholly separated from the stigma *flexuosa*, Walk.

- 15(14). Scutellum with five spots; the above-named two bands united together and with the stigma *quinaria*, sp. nov.
- 16(1). The band over the hind cross-vein is united with the basal one near the small cross-vein.
- 17(18). Wing bands more yellowish; a dark streak on last portion of the fourth longitudinal vein *stictica*, Bezzi.
- 18(17). Wing bands more infuscated; no streak on the fourth vein
inscripta, Grah.

1. **Pardalaspis punctata**, Wiedemann, 1824; Silvestri, Boll. Labor. Zool. Portici, viii, 1913, p. 58, fig. ix.

A widely spread African species, which is known to attack cacao pods.

2. **Pardalaspis bremeri**, Guérin Méneville, Rev. Zool., vi, 1843, p. 199.

Described from Senegal in the female sex and not found subsequently. It is possible that the present species is identical with one or other of the following; but it is larger and in the description there is no mention of black spots on the thorax.

3. **Pardalaspis giffardi**, Bezzi,* Boll. Labor. Zool. Portici, vii, 1912, p. 8, fig. 1 and p. 21; Silvestri, l.c., viii, 1913, p. 54, fig. vi.

Reared by Prof. Silvestri from various fruits in Senegal, French Guinea, Dahomey and South Nigeria.

There is in the collection a female specimen from S. Nigeria, May 1914 (Dr. W. A. Lamborn).

4. **Pardalaspis silvestrii**, Bezzi, Boll. Labor. Zool. Portici, vii, 1912, p. 10, fig. 2; Silvestri, l.c., viii, 1913, p. 56, fig. vii.

Known only from Senegal and French Sudan.

5. **Pardalaspis morstatti**, Bezzi, Boll. Labor. Zool. Portici, vii, 1912, p. 12, fig. 3.

Described from Camerun, Victoria, from where I have received it together with *Pterandrus colae*, Silv., which it much resembles both in general appearance and wing pattern; the middle legs of the male are however entirely simple, and on the front femora the characteristic ciliation of that species is lacking.

6. **Pardalaspis antistictica**, Bezzi, Boll. Labor. Zool. Portici, vii, 1913, p. 20, fig. 1; Silvestri, l.c., viii, 1913, p. 57, fig. viii.

Reared by Prof. Silvestri in South Nigeria from the fruits of a wild plant. It was at first described by me as a variety of *stictica*, Bezzi, but it seems to belong to a distinct species, as shown by the short and broad wings, which have a short discoidal cell, with the small cross-vein situated near its middle.

*[There can now be no doubt that this species is a synonym of *Ceratitis cosyra*, Walk. (see p. 236, and Plate v, fig. 5), a specimen named by Prof. Bezzi having been compared with Walker's type. We have received the species in some numbers from the following localities:—GOLD COAST: Aburi, Feb. and April 1911, bred from fruit of *Landolphia* (*L. Armstrong*); NYASALAND: Chiromo, Dec. 1916, bred from "mtondo" fruit (*R. C. Wood*); S. RHODESIA: Salisbury, Nov. 1914, bred from guavas, and Umtali, Aug. and Sept. 1915 (*R. W. Jack*).—ED.]

7. ***Pardalaspis flexuosa***, Walker, Ins. Saund., iv, 1853, p. 382, v. viii, fig. 2.

Described from the Cape and not found subsequently; the above-quoted figure by Westwood shows a very distinct species, with characteristic scutellum and wing pattern.

8. ***Pardalaspis quinaria***, sp. nov. (Plate v, fig. 6).

Closely allied to the preceding species, but at once distinguished by the five scutellar black spots and by the more complete wing pattern.

♂♀. Length of body, 4·5-5 mm.; of ovipositor, scarcely 1 mm.; of wing, 4·5-5 mm.

Head entirely dull yellowish, grey dusted on the occiput, whitish on the face; frons in the middle with a broad, dark reddish spot, which is ill-defined. Antennae entirely yellow, with a shortly pubescent arista; jowls unspotted. Palpi whitish, without black bristles; proboscis yellowish. Cephalic bristles black or dark brown; oc. thin and long; 2 i. or.; genal bristle thin and yellow. Thorax entirely reddish yellow, paler on the sides, with whitish or pale yellowish pubescence; humeri and sides entirely destitute of black spots; on disc there are two pairs of black dots, like those of *silvestrii*, one at the suture, the other at the dc.; there are also two small black dots on each side, behind the root of the wings. Scutellum pale yellowish, shining, with five equally small, black spots, one at apex and a pair on each side, placed symmetrically. Mesophragma yellow, whitish dusted; hypopleural spot double, whitish. All the bristles black; dc. a little behind the line of the a. sa.; 1 mpl. Halteres whitish. Abdomen pale yellowish, with the 3rd segment distinctly darkened and with greyish bands on hind borders of 1st and 3rd segments; apical bristles reddish or blackish (in the female); ovipositor flat, entirely reddish. Coxae and legs entirely pale yellowish; their bristles and hairs are yellowish, only those of the front femora being black. Wings hyaline, with ill-developed dark basal spots; stigma yellowish, and from it a yellowish band goes over the small cross-vein to the hind border, becoming darker in the third posterior cell and disappearing before reaching the wing margin; the marginal yellowish band united to the stigma, with the usual five blackish dots and infuscated at end; the oblique band over the hind cross-vein is wholly infuscated and is produced only a little beyond the 4th vein above. Last portion of 4th vein without a dark streak. Costal bristle well developed; venation normal; small cross-vein placed on the first third of the rather long discoidal cell.

Type ♂ and type ♀ (British Museum), a single pair from Salisbury, 9th December 1915, bred from apricot (*R. W. Jack*).

9. ***Pardalaspis stictica***, Bezzi, Boll. Lab. Zool. Portici, iii, 1909, p. 278, and vii, 1912, p. 6.

Described from the Congo and found in W. Africa, Ashanti, by Dr. Graham.

10. ***Pardalaspis inscripta***, Graham, Bull. Ent. Res., i, 1910, p. 164.

Described from South Ashanti, Obuasi, and not found subsequently. Its position in the present genus is doubtful, chiefly because the wing pattern seems to be like that characteristic of the following genus *Trirhithrum*.*

*[This species is a *Trirhithrum* and identical with *T. nigerrimum* var. *coffea*, Bezzi (see Plate v, fig. 9).—ED.]

Note.—The two following species seem to belong to the present genus :—

- (a) *Tephritis senegalensis*, Macquart, Suites à Buffon, ii, 1835, p. 468.

Described from Senegal, seems to agree with *P. silvestrii*.

- (b) *Ceratitis cosyra*, Walker, List Dipt. Brit. Mus., iv, 1849, p. 1042.

Described from the Congo. Loew and van Roeder have believed it to be a synonym of *Cer. capitata* ♀; Fuller in 1900* has described under this name the *Pterandrus rubivorus*, Coquillett, or the very destructive "Natal fruit-fly."

VIII. TRIRHITHRUM, gen. nov.

The present genus is considerably different in general colour of body and in pattern of wings from the three preceding genera, and shows more resemblance to the species of *Carpophthoromyia*, with which I united it, as 5th section of *Ceratitis*, in 1913.†

Prof. Silvestri‡ has studied the larva of *T. nigerrimum*, and has found that it shows some very important differences from the larvae of the species now placed in the three preceding genera, chiefly in the antennae and in the anterior spiracles. Thus the erection of a distinct genus for it and its allies seems to be justified.

Type: *Ceratitis nigra*, Graham, 1910.

The rather numerous species of this characteristic Ethiopian genus may be distinguished as follows :—

- 1(6). Last portion of fourth longitudinal vein crossed by an oblique dark band, the so-called middle band; scutellum whitish or pale yellowish, with or without black spots.
- 2(3). Wings with basal streaks and dots and with complete middle band; thorax densely grey tomentose on disc, with shining black sides and with light yellowish humeri and pleural stripe *lycii*, Coq.
- 3(2). Wing base not so patterned; thorax quite shining black, even on disc, humeri and pleurae; scutellum whitish, with broad and confluent black spots behind.
- 4(5). Middle band of wings complete; legs entirely light yellowish
nitidum, v. Röd.
- 5(4). Middle band interrupted in the first posterior cell: femora black
albonigrum, End.
- 6(1). Middle band reduced to a short tooth, which does not reach the fourth longitudinal vein; scutellum entirely black, or only with two very small yellow dots below at end.
- 7(12). The short pubescence on back of thorax entirely black; scutellum without yellow dots below on middle of hind border.

* First Report of the Natal Government Entomologist, 1899–1900, p. 70, and Fourth Report, 1903–1904, p. 19, pl. iii, fig. 1 and 1a (*Cer. corysa*). [As mentioned above, this species is *P. rosa*, Karsch, and not *P. rubivorus*, Coq.—ED.]

† Boll. Labor. Zool. Portici, vii, 1913, p. 22.

‡ Boll. Labor. Zool. Portici, viii, November 1913, p. 3–164, fig. i–lxix. Of this very important work there is an English edition published as Bull. No. 3 of the Division of Entomology of Board of Agric. Hawaii, Honolulu, February 1914.

- 8(11). Third abdominal segment with a complete whitish cross band at hind border ; size greater (5-7 mm.).
- 9(10). Face creamy white on its lower two-thirds ; wings with a triangular hyaline indentation at fore border before the stigma and with the cubital band narrower than the length of the hind cross-vein *nigrum*, Grah.
- 10(9). Face entirely shining black, with only a reddish mouth-border ; wings entirely infuscated before the stigma and with the cubital band as broad as the hind cross-vein *gagatinum*, sp. nov.
- 11(8). Third abdominal segment with only two greyish, triangular spots towards its middle ; frons and occiput of a bright reddish colour ; size smaller (not over 4 mm.) *occipitale*, sp. nov.
- 12(7). The short pubescence on back of thorax entirely whitish ; scutellum with two small yellow dots at hind border.
- 13(14). Base of wings hyaline, with a narrow dark band extending from the humeral cross-vein to the anal cell ; halteres pale ; pleurae grey dusted ; scutellum with two bristles only *bimaculatum*, v. Röd.
- 14(13). Base of wings entirely fuscous, with or without hyaline spots, but with no distinct isolated band ; halteres black ; scutellum with four bristles.
- 15(16). Wings with no hyaline indentation at fore border before the stigma, or if with an indistinct one, the costal vein at any rate entirely black ; face more or less broadly darkened *nigerrimum*, Bezzi.
- 16(15). A well developed hyaline indentation at fore border before the stigma, and the costal vein there broadly pale yellowish ; face entirely cream white, or only narrowly infuscated above, near the root of antennae.
- 17(18). Wings with the stigma infuscated and with the hyaline space between the marginal and cubital bands ending before the small cross-vein ; tibiae mainly yellowish *leucopsis*, var. nov.
- 18(17). Wing: with much paler stigma and with the above-named hyaline space extended to the small cross-vein, at least above ; tibiae mainly black
coffeeae, var. nov.

1. ***Trirhithrum lycii***, Coquillett, Proc. U.S. Nation. Mus., xxiv, 1901, p. 30.

Originally described from specimens bred from *Lycium* sp. in the Cape Colony and not found subsequently. This species agrees in general wing pattern with the present genus, but is in some respects very different from the other species, and its position here is therefore very doubtful.

It is evidently congeneric with *Ceratitis loranthi*, Froggatt (Proc. Linn. Soc. N.S.W., xxxv, 1910, p. 863), bred at Perth, W. Australia, from fruits of *Loranthus pendulus* growing on *Eucalyptus* sp., and of which I have original specimens before me. The two species have a very similar thorax and wing pattern ; but while in *lycii* the middle band of the wings is complete and reaches the hind margin, in *loranthi* it is reduced to a long tooth, which reaches but does not pass the 4th longitudinal vein. The head is not narrowed in profile and the eyes are rounded ; the arista is nearly bare (Coquillett does not mention it in *lycii*) ; the dc. are placed

on the line of the a. sa. ; the small cross-vein is beyond not before the middle of the discoidal cell. The upper terminal angle of the third antennal joint is acute but not produced.

2. **Trirhithrum nitidum**, v. Röder, Berl. Ent. Zeits., xxix, 1885, p. 134.

Described from Delagoa Bay, and very distinct from the other species on account of the complete middle band of the wings. Not found subsequently.

3. **Trirhithrum albonigrum**, Enderlein, Zool. Jahrb., xxxi, 1911, p. 410, fig. A.

Described from Camerun, Barombi, and nearly allied to the preceding species, from which it is distinguished by the interrupted middle band of the wings.

4. **Trirhithrum nigrum**, Graham, Bull. Ent. Res., i, 1910, p. 162, pl. xii, fig. 1 (*obscurum*, Enderlein, 1911).

The present species seems to be widely spread in West Africa, being recorded from South Nigeria, Camerun and the Belgian Congo. I have never seen it, but only the following form, which seems to be distinct, at least as a variety.

5. **Trirhithrum gagatinum**, sp. nov.

Nearly allied to the preceding species, and perhaps only a variety of it, differing in its black face and the entirely infuscated costal cell of the wing.

♀. Length of body, 5.5 mm. ; of ovipositor, 1.5 mm. ; of wing, 5 mm.

Occiput entirely shining black, only dark reddish below at sides ; frons dark yellow, purplish above the antennae, with a black ocellar spot ; face shining black, with the upper mouth-border narrowly reddish ; jowls dark reddish, with a brown spot below the eye. Antennae blackish brown, with a broadly plumose arista. Palpi grey, very broad, with short, black, bristly hairs ; proboscis reddish brown. All the bristles are black, like those of the thorax and scutellum ; 2 i. or. ; oc. very strong ; dc. a little behind the line of a. sa. ; 1 mpl. ; pt. strong. Thorax entirely shining black, even on the pleurae, with the humeri very narrowly and in distinctly reddish ; pubescence of back short and entirely black ; hairs of pleurae longer, but likewise black. Scutellum entirely shining black, only at the sides in distinctly reddish, without yellow apical dots below ; it bears four bristles, and black, rather stout hairs. Mesophragma shining dark brown, like the hypopleura. Halteres black, with brownish stalk. Abdomen entirely shining black, dark brownish at base, with black hairs and numerous black bristles on sides at end ; the transverse band of whitish dust on third segment is narrow and abbreviated at the sides ; the pubescence above it is whitish. Ovipositor triangular, shining black and black pilose ; apical segment reddish. Venter shining black, with brown base. Legs with coxae and femora black, tibiae and tarsi pale yellowish, but the four posterior tibiae are broadly blackened at base ; bristles, spurs and hairs black ; hind tibiae with 4-5 short black bristles at the middle of the posterior edge. Wings as in *nigrum*, but with the base entirely infuscated along the costal cells and with the costal vein entirely black ; the cubital band seems to be broader, covering the whole of the

hind cross-vein. The discoidal cell is almost rectangular in shape, its basal vein being about as long as the apical one; the small cross-vein is placed a little before its middle.

Type ♀ (British Museum), a single specimen from Gold Coast, Aburi, 1912-13 (*W. H. Patterson*).

6. ***Trirhithrum occipitale***, sp. nov. (Plate v, fig. 7).

A very distinct species, being somewhat allied to the two preceding ones on account of the black pubescence of the thorax, but distinguished from all the known species by the bright reddish occiput.

♀ Length of body, 4 mm.; of ovipositor, 1 mm.; of wing, 4 mm.

Occiput reddish, bright ferruginous on the lower swellings, with a dark brown spot on each side of middle; frons bright reddish yellow, without any dark pattern, except the black ocellar spot; face entirely cream-white, only narrowly infuscated above near the roots of antennae; the exceedingly narrow cheeks and the rather narrow jaws are of the colour of the occipital swellings, with a purplish spot below the eye. Antennae entirely dark reddish, with broadly plumose arista. Proboscis black; palpi greyish, with black bristles. All the cephalic bristles are black, but less stout than in the preceding species, chiefly the oc. Thorax entirely shining yellowish even on the humeri and pleurae; the pubescence on back and the hairs on pleurae black, like the bristles; chaetotaxy as in the preceding, but all the bristles weaker. Scutellum and mesophragma, like the thorax and even the hypopleura, quite black; 4 set. Halteres black, with paler stalk, which at base is more yellowish. Abdomen shining black, with black hairs and bristles; first segment with a narrow whitish hind border, which is interrupted in the middle; 2nd and 3rd segment with a double greyish spot in the middle, more developed and distinctly triangular on the third. Ovipositor as in the preceding. Legs black, the tibiae and all the tarsi at end pale yellowish; hind tibiae with a complete row of short bristles. Wing pattern blackish; a great triangular hyaline indentation with the base on the costal cell and the apex in the first basal cell; a broad border of the axillary lobe and the alula are greyish hyaline; there is also a hyaline spot near the base of the anal cell. Costal vein yellowish along the hyaline indentation; stigma blackish. Marginal band with four broad hyaline streaks along the costa; middle band reduced to a well developed tooth; cubital band as broad as the length of the small cross-vein and entirely covering the hind cross-vein; the hyaline space between the marginal and the cubital bands with acute end and not reaching the small cross-vein; basal band ending rather narrowly at end of the anal vein. Discoidal cell narrower at base than at end, the small cross-vein placed much before its middle; lower point of the anal cell longer than the second basal cell.

Type ♀ (British Museum), a single specimen from Nyasaland, Limbe, 4,000 ft., 22nd September 1916 (*R. C. Wood*).

7. ***Trirhithrum bimaculatum***, v. Röder, Berl. ent. Zeits., xxix, 1885, p. 135.

Originally described from Delagoa Bay and not found subsequently. It is said to have only 2 set., a thing which seems probably due to the fact that a pair of bristles was accidentally broken off.

The present species is evidently allied to the following ones, chiefly to the var. *leucopsis*; but it seems to be distinguished by the broadly hyaline base of the wings and by the pale-coloured halteres.

8. ***Trirhithrum nigerrimum***, Bezzi, Boll. Lab. Zool. Portici, vii, 1913, pp. 25 & 36, fig. 3; Silvestri, l.c., viii, 1913, p. 67, fig. xiii.

Bred from various fruits, but especially from coffee berries, by Prof. Silvestri in S. Nigeria, Lagos and Olokemeji; Gold Coast, Aburi; and Camerun, Victoria. Described originally by me as a variety of *nigrum*, and subsequently recognised as a different species by Prof. Silvestri. None of the specimens that I have seen were in good condition, and thus it is not possible at present to have a sure knowledge of this species, which seems to be variable; this variability may perhaps be connected with the fact that the specimens were bred from different plants; some related forms may be present. The colour of the face seems to vary from entirely white to entirely brown; the wings sometimes have a small hyaline indentation at the base (see my figure, in which the basal band is represented too broad at its lower end), which is usually not present.

9. ***Trirhithrum nigerrimum***, var. *leucopsis*, var. nov.

Distinguished by the cream-white face and the hyaline indentation of the costal cell.

♂♀. Length of body, 3.5–4 mm.; of wing, 3.5–4 mm.

Occiput entirely black, only below at sides narrowly pale yellowish; frons in both sexes yellowish grey, with two more or less distinct dark transverse bands towards the middle and with a black ocellar spot; face quite white, like the narrow jowls, which bear a dark spot below the eyes; the face is more or less distinctly infuscated above, near the root of antennae. Antennae entirely yellowish, with a broadly plumose arista; proboscis black; palpi greyish brown. Cephalic bristles black. Thorax entirely black, even on the humeri, pleurae, hypopleurae and mesophragma; the short pubescence of the back is whitish, while the longer hairs of the pleurae are black; chaetotaxy normal, with black bristles. Scutellum like the thorax, but with two very small yellowish dots on middle of hind border, below the set. Abdomen shining black, its grey markings as in *occipitale*, but those of the third segment not triangular in shape; ovipositor shining black, 0.7 mm. long. Legs black; tibiae and tarsi pale yellowish, but the tibiae more or less broadly blackened at base; hind tibiae with a complete row of bristles. Wing pattern and shape of discoidal cell as in *occipitale*.

Type ♂ (British Museum), a single specimen from Nyasaland, Limbe, 4,000 ft., 22nd September 1916 (*R. C. Wood*).

This specimen was caught together with the ♀ type of *occipitale*, but I think it is unlikely that it is the other sex of that species, owing to the different coloration of the head and chiefly of the pubescence of the back of the thorax, which in the known species is always similarly coloured in the two sexes. Besides, I have received from Dr. Mochi a couple of specimens from Erythraea, Ghinda, December 1916, in which the female has the head coloured as in the male, and has whitish pubescence on the back.

10. *Trirhithrum nigerrimum*, var. *coffae*, var. nov.*

Very near the preceding form, but even smaller and distinguished by the characters given in the table.

♂♀. Length of body, 2·8–3 mm.; of wing, 3 mm.

Head, thorax and abdomen as in the preceding variety; but the vertex and the abbreviated lateral stripes of the frons, which are opaque in that form, are in the present distinctly shining. The tibiae are black, with the tip only narrowly pale yellowish. There are some important differences in the wing pattern: (1) The stigma is less infuscated, and before it there is a small black dot on the upper end of the 2nd costal cell; (2) the marginal band is much narrower and very sinuous, because the four hyaline spots of fore border are broader and the two tooth-like projections are more pronounced; (3) the hyaline space between the marginal and the cubital band is not acute at the base, but ends exactly on the small cross-vein, being there truncated obtusely; therefore the cubital band is differently shaped at the base; (4) there is a broad hyaline spot at the base of the 3rd posterior cell, in front of the anal cross-vein.

Type ♂ and type ♀ (British Museum), a single pair of specimens from Gold Coast, Aburi, December 1910 (*L. Armstrong*), bred from coffee berries.

It is curious that Prof. Silvestri at the same locality (Aburi) in January 1913 bred from coffee fruits the form above recorded as *nigerrimum*, which differs from the present one in the colour of the face and wing pattern. These variations may be only individual, or they may depend on the breeding conditions, or even only on the state of preservation of the specimens.

Ceratitis albomaculata, v. Röder (Berl. Ent. Zeits., xxix, 1885, p. 136), from Delagoa Bay, is doubtfully referable to the present genus, but has a similar wing pattern, with basal streaks and no middle band or tooth; it is said however to have the anal cross-vein not deeply sinuous, and is therefore perhaps to be excluded from the allies of *Ceratitis*.

IX. *XANTHORRHACHISTA*, Hendel, 1914.

I will give here an account of the characters of this very peculiar genus, which was recently erected in a few words only by Prof. Hendel.†

Body *Acidia*-like, but more elongate, shining testaceous, with small black dots on the thorax and scutellum. Head in front view distinctly higher than broad, but in profile subquadrate, being much swollen below on account of the very developed lower occipital swellings; cheeks narrow; jowls broad. The position of the head is very peculiar, the neck being inserted very low, so that the head is raised considerably above the front border of the thorax ("Kopf balancierend" of Prof. Hendel). Eyes twice as high as broad, but not much narrowed. Antennae inserted a little above the middle of the eyes, with the third joint rounded at tip and extended a little beyond the middle of the face; arista shortly plumose, the breadth of the feathering being less than the breadth of the 3rd antennal joint. Face with a distinct middle keel in the upper half, flattened below and slightly prominent at the mouth-border. Palpi broad and spatulate, with short bristles; proboscis short and thick.

* [As mentioned above (p. 235) this form is identical with *T. inscriptum*, Graham (1910).—ED.]

† Wien. Ent. Zeit., xxxiii, April 1914, p. 81.
(C419)

Cephalic chaetotaxy complete; oc. rather short; 2 i. or.; ocp. thin, short, acute, yellow. Thorax rather elongate, with the transverse suture broadly interrupted in the middle; chaetotaxy complete, but the middle scp. are wanting, while the exterior ones are strong; dc. placed a little behind the line of a. sa.; only 1 mpl.; pt. stronger than the st. Scutellum broad, triangular with rounded sides, convex above, with four bristles. Abdomen with bristles on sides and at end; male genitalia strongly developed; ovipositor as long as the abdomen, conico-tubular, pubescent above. Legs very long and slender, simple; front femora with a few (3-5) but strong bristles below on apical half; middle tibiae with a single spur; the hind tibiae with a row of sparse but strong bristles. Wings long and proportionally narrow, adorned with longitudinal yellowish bands and an oblique apical streak. Costal bristle short, but distinct; 2nd longitudinal vein straight; 3rd longitudinal vein bristly throughout its whole length, bent below in its last portion and there parallel with the last portion of 4th; small cross-vein placed very near the base of the long and narrow discoidal cell, which is more than twice as long as the 2nd posterior cell; hind cross-vein oblique outwardly, about as in *Ceratitis*; anal cross-vein bent in the middle; lower angle of anal cell with an acute point, which is a little longer than the 2nd basal cell; last portion of 4th vein gently curved above near the base.

1. **Xanthorrhachista cephalia**, Hendel, Wien. ent. Zeit., xxxiii, 1914, p. 81.

A beautiful fly of large size, readily distinguished by the black spots on the thorax and the yellowish longitudinal stripes on the wings.

♂♀. Length of body, 8-9 mm.; of ovipositor, 3 mm.; of wing, 9-10 mm.

Head entirely testaceous, shining only on the occiput; frons more pale yellowish in front and face more whitish; there are no dark spots whatever, even on the ocellar area; occipital swellings whitish below, chiefly in the male, and clothed with pale yellowish hairs. Antennae entirely pale yellowish or whitish; the bristles of the second joint and the arista are yellowish. Palpi pale yellowish or whitish, with yellow hairs and bristles; proboscis dirty testaceous. Cephalic bristles mainly reddish yellow, only the 2 s. or., and sometimes the oc. or one of the i. or. being darkened or even black. Thorax shining testaceous, with the humeri and a mesopleural stripe more or less yellowish or whitish; on the back there is a thin whitish dust and a short pale pubescence; on the pleurae there are longer but sparse whitish hairs. The black dots are small and rounded, disposed as follows: a pair just behind the suture, in front of the dc., being the most conspicuous and shining; two pairs on the sides, velvety opaque, the one just below and behind the a. sa., the other smaller on the postalar callus, near the base of sides of scutellum; more difficult to see is a third small, elongate dot, very near the root of wings. Mesophragma and hypopleural callosities shining yellowish, the latter not forming a distinct spot. Scutellum like the thorax; its three small black dots shining, the apical one placed between the a. set., the lateral ones below and behind the b. set.; on the disc there are sparse and short, yellowish hairs. All the thoracic, scutellar and pleural bristles are reddish yellow in colour. Halteres pale yellowish. Abdomen coloured and shining like the thorax, wholly immaculate; its pubescence reddish yellow, like the bristles, which are sometimes infuscated on the last segments. Male genitalia

reddish yellow, with pale pubescence; ovipositor reddish, shining, with yellowish pubescence. Leg entirely pale yellowish, immaculate, with yellowish pubescence and bristles; the bristles of the front femora very strong in the female. Wings shining, with yellow veins; the base broadly yellow to the small cross-vein; from it there runs a marginal stripe, which does not extend below beyond the 3rd longitudinal vein, being only slightly produced beyond that vein at its apex; this stripe is yellowish in colour, but has some dark spots along the costa (two in the costal and two in the marginal cell) and is besides infuscated at the apex. The second longitudinal stripe, or yellowish ray, runs along the upper vein of the discoidal cell, ending at its apex and there being bent below to form a dark band over the hind cross-vein. A small, oblique, fuscous band crosses the middle of the last portion of the 4th vein, extending from the hind border of the wing to the 3rd vein, which meets the costal stripe. The hind border of the wing is broadly but faintly yellowish-fuscous on the 3rd posterior and axillary cells. The stigma is yellow like the costal stripe, but is broadly and faintly infuscated towards the middle.

I assume the above-described species to be identical with that named, but not described, by Prof. Hendel from E. Africa. There are in the collection some specimens from British East Africa, Masai Reserve, viz. a ♂ from Ngare Narok, 31st December 1913, about 6,000 ft. (*Capt. A. O. Luckman*), and a couple, 2nd April 1913 (*T. J. Anderson*). I have in my collection a male taken at Kikuyu by *Doherty*, and given me many years ago by the late Dr. Magretti, the well-known Dipterologist.

Trypeta jucunda, Loew (Berl. Ent. Zeits., v, 1863, p. 258, pl. ii, fig. 1), from Caffraria, is perhaps allied to this species, but apparently not congeneric with it, on account of its bare arista, short ovipositor and very differently placed small cross-vein; it is besides much darker in body coloration, and the wing pattern is of a very different type.

X. THEMARICTERA, Hendel, 1914.

This genus also was recently erected by Prof. Hendel* on the undescribed type-species *Th. rufipennis* from S. Nigeria. I will give here the essential characters of the genus from a species which I assume to be the *Trypeta flaveolata* of Fabricius and Wiedemann, with which probably the species of Prof. Hendel is identical.

Head very broad, twice as broad as high, and considerably broader than the thorax. Eyes rather rounded, being only a little higher than broad. Frons very broad, not prominent at base, but rather prominent at its apex. Antennae inserted towards the middle of eyes, only a little shorter than the face; 3rd joint rounded at end; arista broadly plumose. Face concave, with a flat, triangular middle keel, rather prominent at mouth-border; antennal grooves narrow and deep. Cheeks moderately broad, jowls very broad; mouth-opening broad. Palpi less dilated at end, bristly; proboscis short. Cephalic chaetotaxy complete, with 2 i. or., the 2nd pair of which is placed much nearer the middle line than the first; but all the other bristles are broken off in the specimen examined. Thorax elongate, with complete chaetotaxy, but the st. wanting (according to Hendel); 1 mpl.; dc. placed much behind, about in the line of the first p. sa. Scutellum proportionally small, flat above, triangular, with two pairs of strong bristles and between these a 3rd pair

* Wien. Entom. Zeit., xxxiii, April 1914, p. 77.

of much weaker ones, which are sometimes hardly distinct. Abdomen elongate, with distinct but not strong bristles on sides and at end; ovipositor conical, long, but a little shorter than the abdomen. Legs rather stout; front femora with 3-4 strong bristles below. Wings long and proportionally narrow, much variegated, having the fore half yellow and the hind half with a broad blackish band and some hyaline indentations along the hind border. Costa densely but shortly ciliated, without a distinct bristle; stigma long; 2nd longitudinal vein wavy; 3rd bristly throughout its whole length, with the last portion a little bent before the middle and parallel with the 4th, the first posterior cell being proportionally narrow and long; discoidal cell much longer than the very short and almost triangular 2nd posterior cell, the small cross-vein placed much beyond the middle and very near the posterior cross-vein, which is rather perpendicular and longer than its distance from the small one; anal cell broad and long, with the lower angle acute and produced but not longer than the second basal cell. In consequence of the breadth of the marginal and sub-marginal cells, the discoidal and posterior cells are narrower than usual, and the discoidal cell is thus placed much nearer to the hind border of the wing than in the related forms.

1. ***Themarictera flaveolata***, Fabricius, 1805; Wiedemann, Auss. Zweifl., ii, 1830, p. 481.

A large and handsome species, obviously recognisable from the short descriptions of Fabricius and Wiedemann.

Head and its appendages wholly reddish yellow; their bristles are entirely black, like those of the thorax and scutellum. Thorax, scutellum and mesophragma entirely reddish yellow and shining, the pleurae being a little paler; the two rounded black spots are placed just above the humeri, one on each side. Abdomen shining and coloured like the thorax, darkened along the middle line, with yellowish pubescence and black bristles; ovipositor black and with black pubescence. Legs entirely yellowish, with pale pubescence and black bristles. Wing pattern well described by Wiedemann.

Originally described from Guinea, there is a ♀ specimen (British Museum) from Dahomey, Cotonou, 70 miles W. of Lagos, 29th May 1914 (*W. A. Lamborn*).

2. ***Themarictera laticeps***, Loew, Berl. entom. Zeitschr., v, 1861, p. 260, pl. ii, fig. 2.

Originally described from Caffraria, and apparently distinct from the preceding species on account of some minor details of the wing pattern.

Of the allied genus *Themara* there is a known Ethiopian species, *T. fallacivena*, Enderlein (Zool. Jahrb., xxxi, 1911, p. 422), described from Fernando Po, and recorded by Dr. Speiser in 1915 from Camerun, Soppo and Victoria.

XI. BARYGLOSSA, gen. nov.

I have to erect here this new genus for a peculiar form, which shows a wing pattern recalling that of some Oriental species of *Rioxa* and *Ptilona* and closely approaching the reticulate type.

Body short and proportionally broad, rather stout. Head low and broad, in front view broader than high. Eyes greatly developed, occupying almost the whole of the

head in profile view and obviously rounded. Occiput flat; frons flat, with parallel sides, prominent only above the antennae, with the middle band thinly pilose. Cheeks linear; jowls very narrow. Antennae inserted towards the middle of eyes, as long as the face; 3rd joint not much longer than broad, rounded at end; arista long and thin, bare. Face shorter than the length of the frons, with a broad but flattened keel extending to the base of the antennae, which are thus rather broadly separated. Mouth-opening less broad; palpi dilated at end, projecting, thickly pilose but not bristly; proboscis exceedingly incrassated (whence the generic name), cylindrical, with broad and fleshy terminal flaps, as long as the length of lower border of head. Cephalic bristles well developed; ocp. long, thin, acute, black; pvt. diverging; oc. long but thin; 2 s. or. and 2 i. or.; mouth-borders bristly on sides. Thorax short and broad, rather flat on the back; chaetotaxy complete, but the bristles rather thin; middle sep. short but distinct; dc. placed much behind, very near the prsc., about on the line of the first p. sa.; 2 mpl.; st. weaker than the pt. Scutellum broad, convex above, rounded on the sides, thinly pilose on the disc, with three pairs of bristles of nearly equal size. Abdomen broadly ovate, with separated segments, thinly pilose, without distinct bristles. Legs short and stout; front femora with long and thin bristles; middle tibiae with a single spur; hind tibiae with no distinct row. Wings proportionally short, rounded outwardly, with no distinct costal bristle. Auxiliary vein distinct and callose at end; costal cell rather broad; 1st longitudinal vein ciliated; stigma a little longer than broad; 2nd longitudinal vein straight, 3rd with very long bristles throughout its whole length, ending near the apex of wing, parallel with the last section of the 4th; discoidal cell twice as long as the second posterior cell, much broader at end than at base, the small cross-vein placed at its middle; hind cross-vein perpendicular, gently arched outwardly; lower angle of the anal cell produced into a very long and narrow point, very like that of *Dacus*. The wings are wholly infuscated, with hyaline indentations and spots.

Type: the following new species:—

1. *Baryglossa histrio*, sp. nov.

A strange insect, very distinct from any other Ethiopian Trypeneid owing to its very thickened proboscis, as well as its peculiar body- and wing-pattern.

♂. Length of body, 5 mm.; of wing, 5 mm.

Head entirely yellowish grey, without any dark pattern, except a small, black ocellar dot. Antennae entirely yellowish, the 3rd joint a little darker; arista fuscous, with yellowish base. Palpi and proboscis wholly yellowish. All the cephalic bristles black, like those of thorax and scutellum. Thorax entirely yellowish grey, opaque, paler on the pleurae, darker on the back, yellow before the scutellum; there are on the back two indistinct longitudinal darker stripes, one on each side of the middle line. The hairs of thorax are dark yellowish, those on the back rather long. Mesophragma brownish, shining below. Scutellum yellow, opaque, with a black terminal spot, which is rounded in shape and fills up the space between the a. sct. Halteres pale yellowish. Abdomen yellow, opaque, with a very striking black pattern, which extends to the sides and apex and is formed by a very small spot at hind border of 1st, by a broader one occupying all the sides of the 2nd, by a still broader on 3rd segment, which may be said to be entirely black with a rounded yellow

spot united with the yellow part of the preceding segment; 4th segment entirely black, being only narrowly yellow at the extreme base; all this black pattern is opaque inwardly and shining laterally and behind, the 4th segment being wholly shining. Venter uniformly whitish yellow. Genitalia black. The whole abdominal pubescence is black. Legs and coxae entirely pale yellowish, unspotted, with pale yellowish pubescence, blackish bristles and black spurs and claws. The wings are dark brown, with the following whitish hyaline indentations and spots: (1) Along the border, an indistinct indentation in the first costal cell; two broader ones of about equal size in the 2nd costal cell; three in the marginal cell, the apical one smaller and more apart; two in the submarginal cell, the first broader and triangular, both extending to the 3rd longitudinal vein; one in the hind half of the first posterior cell; three in the second posterior cell, the middle one being longer and stripe-like; three in the third posterior cell, extending to the fifth vein and partly fused together. The axillary lobe is nearly entirely yellow. (2) The discal spots are: one in the middle of the submarginal cell, just behind the apex of the triangular indentation of the marginal cell; one in the first basal cell before the small cross-vein, and beyond this two others at equal distance in the first posterior cell, disposed in the same line with the preceding and followed by two more, one above the other, the second being of greater size; two in the discoidal cell, that in the middle being broader and extending to the 5th vein. The anal cell is broadly hyaline towards its middle. The stigma is wholly black. The costal vein is yellowish on the hyaline indentations, and black on the dark parts; the other veins are dark brown.

Type ♂ (British Museum), and an additional specimen of same sex, from Congo belge, Mayumbe (*R. Mayné*).

XII. CLADODERRIS, Bezzi, 1914.

Of this aberrant genus recently described by me,* I have seen only the typical specimens collected at Aburi, Gold Coast, by Prof. Silvestri.

The want of the i. or. as well as the form of the head are perhaps indications that the form belongs to the ORTALIDAE, like the strange *Agrochira* (*Mesanopin*) *tephritina*, Enderlein, 1912, some specimens of which are present in the collection, from Durban, 16th May 1915 (*L. Bevis*). I have seen an allied form from the Philippine Islands, collected by Prof. C. F. Baker.

XIII. PTILONIOLA, Hendel, 1914.

A genus recently erected by Prof. Hendel† and owing to its wing pattern obviously related to the group of the numerous Oriental forms near *Ptilona*, *Rioxa*, *Rioxoptilona*, etc.

Owing to the fact that in my species there are rudimentary but distinct oc., and the posterior femora have not distinct bristles below, I will give here an account of the generic characters, based on the single species known to me, viz. the following one described as new:—

Head in front view a little broader than high, not compressed; occiput flat, only slightly concave above, with the lower lateral swellings not much developed, but

* Boll. Lab. Zool. Portici, viii, May 1914, p. 303, fig. iii.

† Wien. Ent. Zeit., xxxiii, 1914, p. 79.

distinct; eyes rounded, about as broad as high; frons very narrow, distinctly narrower than the eye, with parallel sides, not prominent in profile, even at base of antennae; lunula broad; face narrow above and widened below, with a flat, triangular middle keel and rather prominent at mouth-border; cheeks linear; jowls narrow. Antennae inserted towards the middle of the eyes, shorter than the face; 3rd joint rounded at end; arista plumose, but not broadly. Palpi not or but little dilated at end, bristly; proboscis short. Ocp. strong, numerous, acute, black; oc. very short and thin, but distinct; 2 i. or.; genal bristle strong. Thorax elongate, with parallel sides, flat above; chaetotaxy complete, with strong bristles; dc. placed much behind, near the line of the first p. sa.; middle scp. as thin as the outer ones; one strong mpl. and below this a smaller one; st. much stronger than the pt. Scutellum flat above, triangular, with lateral keels, bare on the disc, with four strong bristles. Abdomen ovate, not longer than the thorax, with strong bristles on sides and at end. Ovipositor flat, triangular, not longer than the half of the abdomen. Legs not elongated; front femora with 4-5 strong bristles below; middle tibiae with one spur; hind femora without bristles below; hind tibiae with a distinct posterior row. Wings proportionally narrow and long, entirely infuscated, with hyaline indentations and spots. No distinct costal bristle; stigma elongated, more than three times as long as broad; 1st longitudinal vein with stout bristles and ending above the small cross-vein; 2nd vein straight; 3rd bristly throughout its whole length, exactly parallel with the last section of the 4th; the segment of the costa between the ends of 1st and 2nd longitudinal veins only a little longer than that between the 2nd and 3rd; small cross-vein beyond the middle of the discoidal cell, which is much broader at end than at base; hind cross-vein perpendicular, a little arched outwardly, about as long as its distance from the small one; lower angle of the anal cell rather short and broad, triangular, shorter than the 2nd basal cell.

1. *Ptiloniola neavei*, sp. nov.

A very distinct species on account of its entirely infuscated wings, which have only a few narrow hyaline spaces.

♂ ♀. Length of body, 6-7 mm.; of ovipositor, 1 mm.; of wing, 7-8 mm.

Head entirely reddish yellow, paler below and on the occipital swellings; occiput with a blackish horizontal stripe extending from the neck to the lower edge of the eyes and forming a continuation of the dark notopleural stripe; frons unspotted, with only a narrow, black ocellar dot; jowls unspotted; antennae, palpi and proboscis pale reddish yellow. Cephalic bristles black, except the genal bristle, which is yellow; frontal band with sparse, scattered, short hairs; occiput below with long, whitish pile. Thorax reddish testaceous on the back, pale yellowish on the pleurae, these two parts being separated by the blackish, narrow, horizontal notopleural stripe, extending from the humeri to the root of the wings; the back rather shining, with short pale yellowish pubescence; pleurae shining, with longer whitish pile. All the bristles black, but the second mpl., the pt. and the strong st. yellow. Scutellum like the thorax and with the sct. black. Mesophragma shining testaceous, infuscated on the sides, where the hypopleural callosities are pale yellowish like the pleurae. Halteres with yellowish stalk and blackish knob. Abdomen rather shining, testaceous towards the middle, black on the sides and on the whole of last

segment ; pubescence and bristles black ; venter yellowish ; ovipositor black. Legs and coxae entirely pale yellowish, with whitish pubescence and yellow bristles ; only the apical spur of the middle tibiae and the tip of the claws are black. Wings wholly infuscated, more intensively on the elongated stigma and near the end of fore border ; there is a small rectangular hyaline spot on the costa, just behind the upper end of the stigma, as long as one third or one half of the marginal cell ; another small hyaline rounded indentation at the middle of the 2nd posterior cell on the wing border ; the 3rd posterior cell at hind border and almost the whole of the axillary cell are greyish hyaline. In the middle of the wing there is always present a small, rounded, hyaline dot at the middle of the base of the 1st posterior cell, a little before the hind cross-vein ; besides there are more or less distinct traces of two other dots, one in the discoidal cell below the small cross-vein, and one in the 1st basal cell ; these three dots are placed symmetrically around the small cross-vein, thus forming nearly an equilateral triangle. The veins are blackish, with yellowish base.

Type ♂ and type ♀ (British Museum) and some additional specimens from Nyasaland, Mt. Mlanje, 22-26th November 1912, collected by *S. A. Neave*, in whose honour the species is named.

This species is certainly distinct from the undescribed type-species of the genus, *P. preussi*, Hendel, 1914, from Camerun.

2. *Ptiloniola tripunctulata*, Karsch, Ent. Nachr., xiii, 1887, p. 5, fig. 4.

Described from Pungo Andongo, W. Africa, as a *Hemilea*. The figure of the wing pattern shows a great resemblance to that of the above-described *neavei*, but the three hyaline discal spots are more developed, and that of the discoidal cell, instead of being placed near the small cross-vein, is very near the hind one, and therefore they are not disposed symmetrically as in *neavei*. The thorax is described as having two (not one) blackish stripes on each side.

Perhaps it will be found that the present species is the same as *preussi*, if the hind femora prove to be provided with bristles.

Note.—I do not know what is the genus *Coelopacidia*, with the type-species *C. madagascariensis*, Enderlein (Zool. Jahrb., xxxi, 1911, p. 442), from Madagascar, and I am unable to establish its systematic position. The author places it near *Acidia*, but in Prof. Hendel's table it comes near *Platyparea*.

XIV. RHACOCOLAENA, Loew, 1862.

This genus, which was founded on a very rare European species, is clearly differentiated from all the others here recorded on account of the complete want of the prst. ; a character which it shares only with the genus *Staurella* and which seems to be only rarely present in Ethiopian Trypaneids. As I have before me the single Ethiopian species of the present genus, which was described by Loew in a few words only, I will give here a complete description of it :—

1. *Rhacochlaena fasciolata*, Loew, Wien. Ent. Monats., vii, 1863, p. 16 (fig. 2).

The two broad shining black spots of occiput extend obliquely from the insertion of the neck to the upper edge of the eyes ; they are narrowly margined with yellow. The frons is dull, shining only near the vertex, with a black ocellar spot and a dark

ill-defined spot towards the middle; cheeks linear; jowls narrow, unspotted. Antennae wholly pale yellowish; arista pubescent, with distinct but short hairs. Proboscis and palpi pale yellowish, the latter with black bristles. All the cephalic bristles are black; 3 i. or.; no oc.; ocp. thin, acute, black. Thorax on back rather dull, with indistinct pale pubescence; all the bristles black; dc. placed much behind, almost in a line with the first p. sa.; 2 mpl.; pt. as strong as the st.; middle sep. rudimentary. Hypopleural spot whitish. Scutellum triangular, with distinct lateral keels, bare on the disc, with four black bristles. Halteres pale yellowish. Abdomen with black pubescence and stout black bristles at the end; it is almost entirely shining blackish brown, with a yellow middle spot on the second segment, extending in front over the hind border of the first segment. Male genitalia shining black,

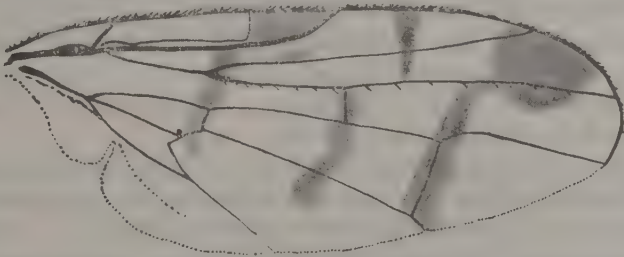


Fig. 2. Wing of *Rhacochaena fasciolata*, Loew.

with yellow base; venter with the sternites pale yellowish, with a black basal spot. Legs entirely pale yellowish; hind tibiae with a row of long bristles. For the wing pattern see the figure. The 3rd longitudinal vein is bristly throughout its whole length; costal bristle small, but distinct; small cross-vein placed after the middle of the discoidal cell.

Originally described from Orange Free State, Bloemfontein (*Tollin*), I have received from Prot. Hendel a male specimen likewise from the Orange Free State, Bothaville, 15th December 1898 (*Dr. H. Brauns*).

2. ***Rhacochaena hammersteini***, Enderlein, Zool. Jahrb., xxxi, 1911, p. 440, fig. R.

Described from Madagascar, as a *Euphranta*, and apparently belonging to the present genus, like *Trypeta lemniscata* from Formosa.

Note.—The widely spread genus *Phorellia*, Robineau-Desvoidy, 1830 (= *Spilographa*, Loew), is certainly present in the Ethiopian Region, but I have not seen specimens belonging to it. It seems that the two following species may be placed in it: (a) *Forellia brunithorax*, Robineau-Desvoidy, Myod., p. 762, from Mauritius; and (b) *Acidia tristriata*, Karsch, Ent. Nachr., xiii, 1887, p. 7, fig. 6, from W. Africa, Pungo Andongo.

XV. **PHILOPHYLLA**, Rondani, 1870.

Of the Ethiopian species described as "*Acidia*," I think that the following may be provisionally placed in the present, eminently characteristic genus:—

- (a) *Acidia obnubila*, Karsch (Ent. Nachr., xiii, p. 6, fig. 5), from W. Africa, Pungo Andongo;

- (b) *Acidia coloniarum*, Speiser (Deut. Ent. Zeits., 1915, p. 102), from Camerun, Victoria, and also from East Africa, Ligiale.
 (c) *Acidia scychellensis*, Lamb (Trans. Linn. Soc. London, Zool., xvi, 1914, p. 316, fig. 10 and pl. 19, fig. 6), from the Seychelles.
 (d) *Acidia* (?) *ocellata*, Lamb (l.c., p. 317, fig. 11 and pl. 19, fig. 7, 8), from the Seychelles.

Trypeta guttatolimbata, Enderlein (Zool. Jahrb., xxxi, 1911, p. 429, fig. K), probably belongs here, but has a very peculiar wing pattern, and requires the formation of a new genus; it is described from Madagascar.

XVI. OCNEROS, O. G. Costa, 1844.

The following three species, all described by Loew, seem to be referable to this genus. They may be distinguished as follows:—

- 1(2). Scutellum entirely yellow; discoidal cell wholly infuscated, without hyaline spots; stigma longer than the 2nd costal cell *sinuatus*, Loew.
- 2(1). Scutellum broadly black in the middle; discoidal cell with hyaline spots; stigma shorter than the 2nd costal cell.
- 3(4). The hyaline indentation at fore border behind the stigma ends before reaching the 2nd longitudinal vein; the two last abdominal segments of the female have at hind border a broad, yellow, transverse band *mundus*, Loew.
- 4(3). The above-named indentation extends into the 1st posterior cell and ends at the 4th longitudinal vein, near the upper end of the posterior cross-vein; the last two abdominal segments of the female are entirely black
excellens, Loew.

1. *Ocneros sinuatus*, Loew, Berl. Ent. Zeits., v, 1861, p. 263, pl. ii, fig. 4.

Easily distinguished by the black wing pattern being more extended than in the other species; the band over the hind cross-vein however does not reach the hind border of the wing.

Described from Caffraria, and not found subsequently.

2. *Ocneros mundus*, Loew, Wien. Ent. Monats., vii, 1863, p. 16.

In this species the black wing pattern (fig. 3) is less extended than in *sinuatus*, but more than in *excellens*. It agrees in all respects with the following species, but is distinguished by the characters given in the table. The basal half of the first

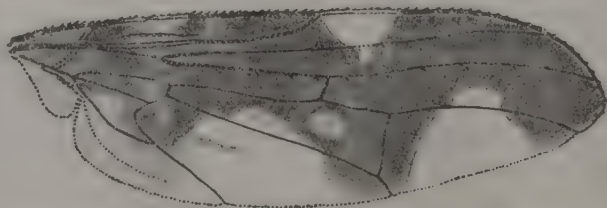


Fig. 3. Wing of *Ocneros mundus*, Loew.

posterior cell is in the present species wholly black, while in *sinuatus* it has a small, rounded, hyaline dot and in *excellens* it is reached by the lower corner of the hyaline indentation beyond the stigma.

Described from the Orange Free State, Bloemfontein (*Tollin*), I have a ♀ specimen from Natal, Estcourt, September–October 1896 (*G. A. K. Marshall*), received from the British Museum many years ago as *excellens*.

3. **Ocneros excellens**, Loew, Berl. Ent. Zeits., v, 1861, p. 265, pl. ii, fig. 5.

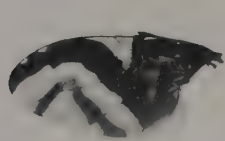
Very distinct from the other species owing to the more reduced wing pattern.

In this and in the preceding species all the bristles of the head and body are black ; there are 2 i. or. ; no oc. ; ocp. acute and black ; middle scp. well developed ; dc. placed about on the line of the first p. sa. ; 2 equally strong mpl. ; st. strong ; pt. weak or even indistinct. The scutellum rather convex and rounded, bare on the disc, with 4 set.

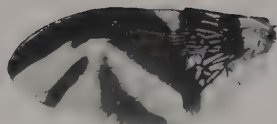
Originally described from Caffraria, I have received a ♀ specimen from Grahamstown from the Albany Museum.

EXPLANATION OF PLATE V.

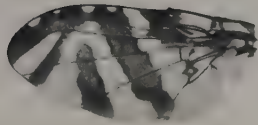
- Fig. 1. *Carpophthoromyia pseudotrítea*, Bezzi, sp. n.
2. „ „ *superba*, Bezzi, sp. n.
3. *Leucotaeniella trispila*, Bezzi, sp. n.
4. *Pterandrus kolae*, Silv.
5. *Pardalaspis cosyra*, Walk. (*giffardi*, Bezzi).
6. „ „ *quinaria*, Bezzi, sp. n.
7. *Tririthrum occipitale*, Bezzi, sp. n.
8. *Xanthorrhachista cephalia*, Hend.
9. *Tririthrum inscriptum*, Graham (*nigerrimum* var. *coffae*, Bezzi).
10. *Themarictera flaveolata*, F.
11. *Ptiloniola neavei*, Bezzi, sp. n.
12. *Baryglossa histrio*, Bezzi, sp. n.



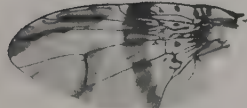
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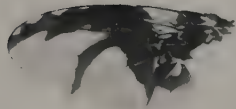
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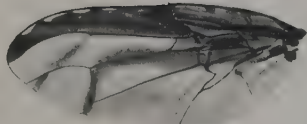
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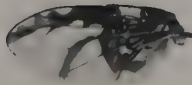
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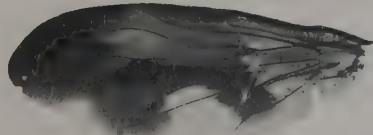
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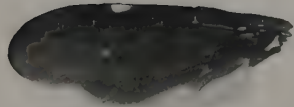
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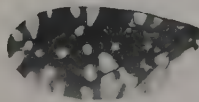
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12

Wings of African Trypanidæ.

THE STRUCTURE OF THE MOUTH-PARTS OF *PANGONIA LONGIROSTRIS*
IN RELATION TO THE PROBABLE FEEDING-HABITS OF THE SPECIES.

By H. TETLEY, B.Sc. (Leeds).

(From the Dept. of Agricultural Entomology, Manchester University.)

(PLATE VI.)

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The present research was carried out in the Department of Agricultural Entomology at Manchester University, under the direction of Dr. A. D. Imms. I am greatly indebted to him both for giving me the insects upon which this research was prosecuted, and also for much help at the University, and afterwards in looking over my paper and aiding its publication.

I. Habits and Economic Significance of the Genus *Pangonia*.

Pangonia longirostris is one of the Orthorrhapha Brachycera, of the family TABANIDAE and sub-family PANGONIINAE. This fly was first described by Hardwicke in the Transactions of the Linnaean Society of 1825 from specimens taken in Nepal. His description is as follows:—

“*P. villosa* flava, thorace ferrugineo, abdomine nigro-brunneo: segmentorum marginibus flavis, alis immaculatis.

“Rostrum about twelve times longer than the head. Antennae approximated at the base, short, consisting of three pieces, the two lowest of which are very small, the upper one long, tapering to a point, and composed of eight small articulations. Eyes large, very prominent. Head and thorax very hairy both above and beneath, longer under the throat; of a bright yellow beneath, brownish above. Wings longer than the body, hyaline; costal nervures brown. Body black; the margins of each segment shining, the sides hairy. Halteres short, having the shafts yellow and the knobs ovate, black.

"Length of the insect from the base of the rostrum to the apex of the abdomen ten lines; and of the rostrum two inches and a half."

This species was redescribed by Röder in 1881.

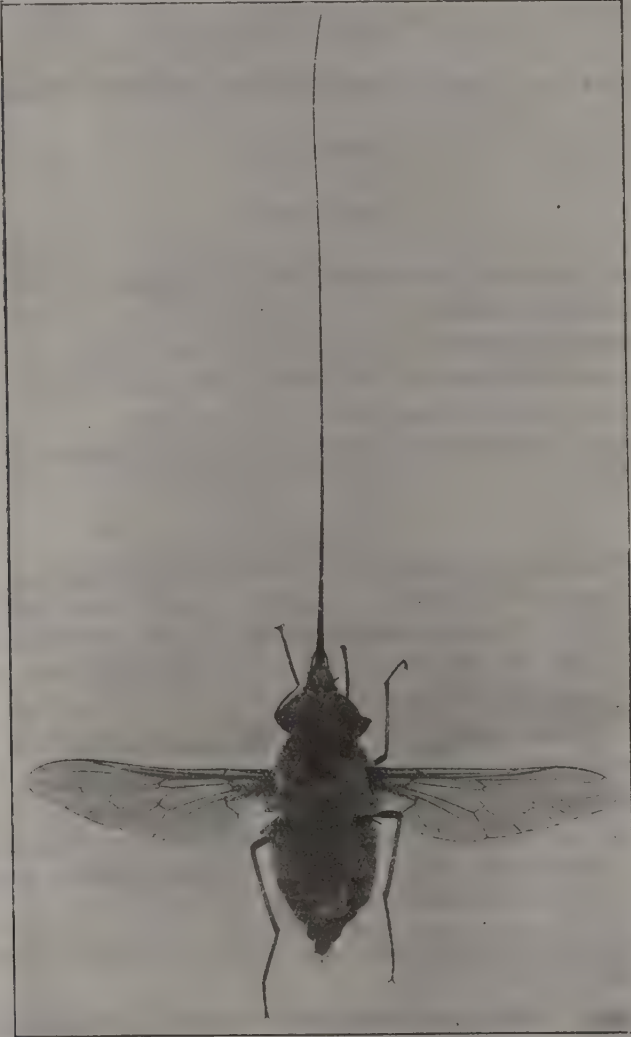


Fig. 1. *Pangonia longirostris*, Hardw., ♂ ($\times 2$).

The geographical distribution of the genus *Pangonia* is a wide one, species being found in Spain, Southern France, Russia, throughout a large part of Africa, in India, Australia, New Caledonia, Chili, Brazil and Canada. In this genus there is

to be found a series beginning with those types that have a proboscis that hardly extends beyond the head, and ending with *Pangonia longirostris* in which it extends to a distance greatly exceeding the length of the body. The precise economic importance of the family TABANIDÆ seems to be doubtful at present. Austen (2) in 1909 says that it has not been proved or even seriously suggested that any species of *Pangonia* is the regular transmitter of any micro-organism pathogenic to animals or man. According to Fantham, Stephens and Theobald (5) in 1916, Martoglio says that the trypanosome disease of dromedaries known as *salaf* is "transmitted" by TABANIDÆ, especially *Pangonia magretti* and *P. beckeri*, in Italian Somaliland.

In addition to this, the same three authors state that *Haematopota* can carry *Trypanosoma evansi* (causing surra in horses) and that *Chrysops* conveys *Filaria loa* in Southern Nigeria, and in Algeria Dr. E. Sergent has proved that a species of *Tabanus* can transmit three forms of animal trypanosomiasis.* From this it is evident that the TABANIDÆ are of importance from an economic view, and further investigation may show this importance to be greater than has been demonstrated at present. It is one of the characteristics of the family to which *Pangonia* belongs that the males are without mandibles, and do not feed on blood to anything approaching the same extent that the females do; they seem to feed chiefly on the nectar of flowers. In the genus *Pangonia* are many species with a very long proboscis, and Lutz (quoted by Austen) thinks that this points to a liquid diet other than blood. From his own observations Lutz doubts whether species in which such an organ exists bite and suck blood on the wing. This agrees with the view of Mr. Ll. Lloyd who writes that "the long proboscis in the PANGONINÆ is used to extract the nectar from flowers which they do while hovering, much in the manner of many Sphingid moths." The experience of Dr. Imms in India with *Pangonia longirostris* is that they are found on the borders of forests towards the end of the rainy season, feeding on flowers of the orders Scrophulariaceae and Labiatae by thrusting their proboscis into them, poisoning themselves in the air during the process. He has never seen them attacking man or cattle, and in an experiment which he carried out by enclosing his arm in a loose gauze sleeve containing a female of this species, he found that the insect showed no inclination to use its mouth-parts. This experiment, Dr. Imms informs me, cannot be regarded as conclusive, as the insect had not full freedom for hovering on the wing.

Various species of *Pangonia* have been found attacking man or cattle in different parts of the world, and their methods of attack differ considerably in the experience of the observers. This fact appears to me to be natural owing to the variation in the relative lengths of the labium and the other trophi.

Westermann [quoted both by Westwood (20) and Austen (2)] found *Pangonia rostrata* a very troublesome species to domestic animals at the Cape, but says that this species seems to prefer the flowers of *Pelargonium*. He held the view that, owing to the length of the proboscis, it can bite only when on the wing. In the opinion of Westwood (20) *P. longirostris* could not use its lancets, except by

* [M. B. Mitzmain has demonstrated the transmission of surra by *Tabanus striatus*, F., in the Philippines.—ED.]

detaching them from the labium and holding the latter at a wide angle from the other parts of the mouth. Bates found, on a southern tributary of the Amazon, a *Pangonia* with a proboscis half an inch long and sharper than the finest needle; this insect settled on the backs of his party and pricked them through their clothing. Sharp (16), speaking of the genus *Pangonia*, says that "The proboscis in the females of some of the species is three or four times the length of the body, and as it is stiff and needle-like the creature can use it while hovering on the wing, and will pierce the human body even through clothing of considerable thickness."

I will not comment on this at present except to say that the implied difference in length of proboscis between the male and female is not mentioned, so far as I can find out, in any species of *Pangonia*, and does not apply to *Pangonia longirostris*, as will be seen from the table of the lengths of the mouth-parts of the two sexes of this insect. According to Patton and Cragg (13) "there is evidence that some of these flies, notwithstanding the great length of the proboscis, feed on mammalian blood . . . while hovering near by, making sudden darts. . . . Such a habit is apparently exceptional in the genus, as in the majority of cases the mandibles and maxillae are shorter than the labium, and cannot, therefore, be employed in making a wound." Austen (2) considers that the fact that, in such species as *P. rostrata* and *P. gulosa* (of Africa) there occurs the great extension of the proboscis beyond the piercing stylets, would obviously offer a mechanical obstacle to the piercing of the skin of a mammal by these flies. He thinks it possible that when such flies appear to be attacking animals, they are merely sucking up the blood flowing from wounds caused by other TABANIDAE.

In two more instances taken from Austen (2), the methods of blood-sucking are given. *Pangonia rapelli* was seen attacking horses in Northern Nigeria; it did this by sucking blood on the wing, and darted away after feeding. Dr. Old (12) says of *P. oldii* that it "hovers for a few seconds, alights, and then deliberately punctures, like a needle, with its extraordinary proboscis."

Neave (11) also mentions that individuals of this species were inclined to enter tents and the females occasionally attacked the bare skins of the natives.

Wesché (19), writing in 1904, remarks that "In *Pangonia* is found an extraordinary development in the length of the labium without the geniculation that usually accompanies this character. This enables these insects to pierce through clothing to the skin."

In 1916 Prof. Poulton exhibited at the Entomological Society of London a specimen of what was probably a form of *P. oldii*, Aust. (vide *Proc. Entom. Soc.* 1916, p. lxxii) and read some notes written by Dr. G. D. H. Carpenter, who had conducted some observations in German East Africa. The latter wrote, "I was bitten one day [16th June 1916] in this locality [30° 55' E., 2° 5' S.] by a *Pangonia*, the first I have met. I heard its hum (an unmistakable Tabanid hum), and looking towards the sound saw what I thought was a fine Bombyliid hovering at my bare forearm sucking up moisture from the skin, as Syrphids often do. The proboscis seemed to me to be laid along the surface. I could not quite reconcile the Tabanid hum with the Bombyliid appearance, and was interested to notice that the proboscis was

shrinking, *i.e.*, its tip had penetrated, but obliquely and so gradually that I had not felt it. So it seems that this species feeds on the wing. I send the specimen. I had always wondered how *Pangonia* managed its long proboscis."

A little later in the same year Prof. Poulton exhibited another *Pangonia* which had been identified by Austen as *P. varicolor*, Wied., and was captured by W. J. Burchell at Uitenhage on 27th Nov. 1813 (vide *Proc. Entom. Soc.* 1916, p. xc). Burchell had added in a manuscript catalogue, under the same number which the specimen bears, "The fly that sucks the oxen without settling upon them."

Prof. H. Maxwell Lefroy (who has kindly allowed me to use the information) has observed *Pangonia* attacking cattle in India. He says that they make wounds with the mandibles, turning up the proboscis as an elephant does its trunk. They then back a little and suck up the blood by means of the proboscis. They are walking and not hovering at the time.

This description agrees with one given by Roubaud (15) in an account of an experiment he carried out in Senegal-Niger, West Africa, with a *Pangonia*; the species was undetermined, nor does he mention the sex, but I take it to be a female. The insect was confined in a muslin cage and this was placed on the author's bare arm to see if the *Pangonia* would bite, but beyond the testing of the skin with the labella, there was no result. A piece of sugar soaked in water was placed in the cage, and after leaving the insect feeding on it for a quarter of an hour, the cage was replaced on the author's arm. This time blood-sucking started at once, and continued without a break for 7-8 minutes at a temperature of 23-25° C., when the insect was fully fed. This experiment seems to show that a meal of nectar would precede any blood-sucking.

M. Roubaud concludes his account thus :—"These observations show the biting rôle and the manifest blood-sucking habits of *Pangonia*. There is no doubt that by reason of the large size of the wounding apparatus, tropical pathology and biology must henceforth reckon with these curious TABANIDÆ."

From the above descriptions it will be seen that the possible processes of blood-sucking in the species of *Pangonia* may be classed as follows :—

1. The insect punctures and sucks up the blood through the proboscis alone, while on the wing.
2. The insect alights and punctures with its proboscis.
3. The insect alights, punctures with its other trophi, and then sucks up blood through its proboscis.

I shall return again to this subject after giving a description of the mouth-parts in both sexes of *Pangonia longirostris*.

I am indebted to Dr. A. D. Imms for supplying me with the two pairs of insects upon which this research was carried out. These were preserved in alcohol and were taken by him at Bhowali, in the Kumaon Himalaya, at an altitude of about five thousand feet, on 7th August 1912.

II. Mouth-parts of the Female (text-fig. 2).

(1). *Mandible* (Pl. vi, fig. 2).—A strong chitinous blade 10 mm. in length, with the greatest width (near the base) of ·53 mm., and tapering gradually towards the apex; the width half-way along its length being ·30 mm. At ·2 mm. from the apex, it narrows more abruptly to a sharp point, which is more strongly

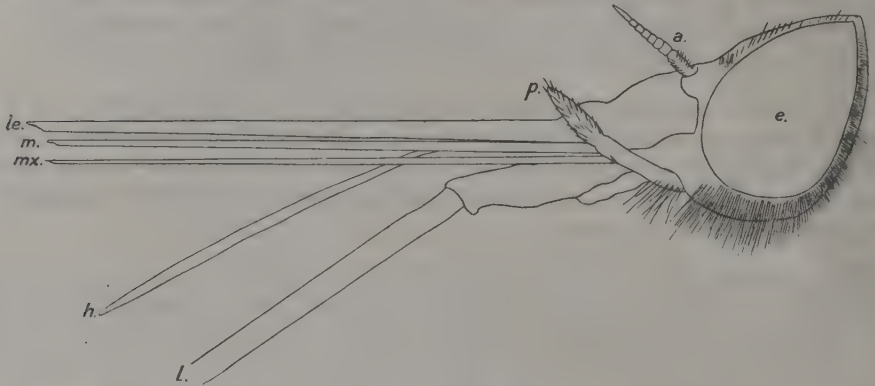


Fig. 2. Lateral view of the head of *P. longirostris*, ♀ ($\times 5$): *a*, antenna; *e*, eye; *h*, hypopharynx; *l*, labium; *le*, labrum-epipharynx; *m*, mandible; *mx*, maxilla; *p*, maxillary palp. Owing to its great length only the proximal portion of the labium is shown.

chitinised than the rest of the blade. Very small teeth are found on both sides of the apex; those on the inner side extend to a distance of ·1 mm., but the outer ones occur as far down as 3·2 mm. from the tip of the mandible, and then become minute (text-fig. 3).

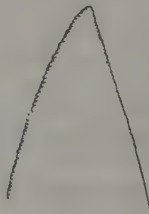


Fig. 3. Apex of left mandible of ♀ greatly enlarged.

The inner edge of the mandible is produced proximally into a strongly chitinised rod which articulates with a second much shorter rod. From the proximal end of the outer edge there arises another short, curved and pointed rod, which, together with the projection from the inner edge, forms a horseshoe-shaped end to the mandible, in which the inner end of the horseshoe is prolonged beyond the outer one. To this outer projection the abductor rectus muscle is attached.

(2). *Maxilla* (Pl. vi, fig. 3).—This is composed of a cardo, stipes, lacinia, galea and palp. Of these, the cardo is articulated with the head skeleton at a point

which lies internal to, and further back than, the articulation of the mandible; it is spindle-shaped, .74 mm. long, and has a strongly chitinised ridge running down its length.

The *stipes* cannot be distinctly separated off from the galea. It articulates with the distal end of the cardo, and from here to the base of the palp it is strongly concave outwards, but then curves in the opposite direction and merges into the galea.

The *lacinia* is a curved projection from the base of the inner edge of the galea; it has a pointed end directed towards the base of the head.

The *galea* is a long narrow chitinous rod, of the same length but not as broad as the mandible, the greatest width being .35-.37 mm. Its basal portion is evenly chitinised throughout its breadth, but more distally the chitin is concentrated into a narrow darker band, which runs to the apex. The latter is rounded and covered with numerous rows of teeth, which point backwards (text-fig. 4). The teeth are deep basally, but are produced into thin flattened or pointed ends. On the outer edge of the galea the teeth continue only for a short distance, hairs arising part of the way down and then continuing down towards the base beyond the point where the teeth disappear. Teeth are found on the inner edge to a point further down than the

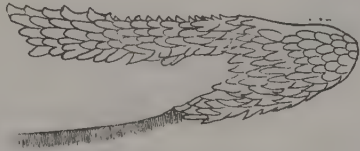


Fig. 4. Apex of left maxilla (galea) of ♀; greatly enlarged.

outer edge, but they gradually become less numerous and then are no longer evident. Some of the more distal of these teeth point inwards. Following a small gap, hairs arise and are continuous down to the base.

Maxillary palp.—This consists of two joints, and arises from the soft membrane on the external border of the base of the galea, and not from any chitinous part. The proximal joint of the palp is expanded at the base, and passes forward as a long rod, slightly curved outwards and of uniform width; its edge is deeply chitinised and corrugated. At the junction with the second joint it expands slightly, and from this region two rows of stiff hairs arise at the edge and converge, passing for some distance down the first joint. The second, or distal, joint is swollen near the base and then tapers to a blunt end, being about three-quarters of the length of the first joint. Both joints of the palp are covered with hairs; at the base of the first joint are a few long, slightly pigmented setae, in addition to a continuous covering of short hairs; higher up are a few more darkly pigmented hairs of medium length, each arising from a conspicuous rounded base. On the proximal part of the second joint is a thick clothing of short stiff darkly-pigmented hairs or spines; hairs are also found to the extremity of the joint, the stiff ones being succeeded by others which are finer and more transparent. In addition to

these, there are a number of very dark long hairs scattered irregularly over the surface, and on this joint is an oval area of circular thick-walled cells.

Wesché has laid down the rule that "the maxillary palpi when present in Diptera are always in contact with the stipites and cardines of the maxillae," and in the *Journal of the Royal Microscopical Society* for 1904 he gives a figure of a dorsal view of the mouth-parts of a male of *Pangonia longirostris*, in which he marks the palp as maxillary palp. The assumption from this would be that the palps are in contact with the basal joints of the maxillae, but I did not find this to be the case in the specimens I dissected, the palps arising, as stated above, from the soft membrane adjoining the external border of the base of the galea. If Wesché's rule be accepted, the palps should, in my opinion, be called the labial palps, but it seems more likely that, from their close association with the maxillae, they are really not labial palps, but maxillary.

(3). *Labrum-epipharynx* (Pl. vi, fig. 5).—Strong, deeply chitinised in its basal third, broad at the base and gradually tapering distally until, at a short distance from the apex, it narrows more abruptly. It then widens out again, and again

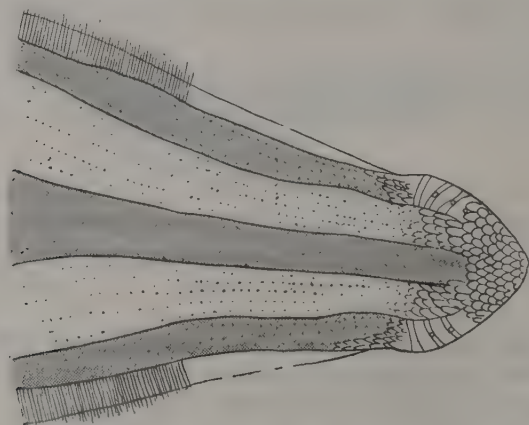


Fig. 5. Apex of labrum-epipharynx of ♀;
greatly enlarged.

narrows, forming a somewhat blunt extremity. I have not been able to separate the labrum from the epipharynx, but in the preparations I have made I can see clearly that there is a central portion which is directly continuous with the fulcrum, and this I take to be the epipharynx, as described by Cragg in the case of *Haematopota pluvialis*. The basal external corners of the labrum articulate with two strong curved rods, which lie in the wall of the head. The apex (text-fig. 5) is covered with numerous rounded teeth which are directed backwards, and on the outer edges of its base there are three ridges on each side, which run diagonally from the edge towards the centre. Behind these ridges the teeth are continued for a short distance on the edges of the labrum-epipharynx, but in the centre they pass gradually into rows of minute hairs, which continue for some way down. A strengthening of the

apex is effected by a strong chitination of the central portion forming a straight rod. This structure tapers slightly distally, and divides at the base into two rods, each of which passes to the edge of the labrum-epipharynx. The sides of the whole organ are hairy, starting from a point which is half-way down the chitinous rod and continuing towards the base, the hairs decreasing in size. Ventrally a channel is formed by the downward extension of the edges of this organ.

(4). *Hypopharynx* (Pl. vi, fig. 4).—A slender tapering rod, but swelling out near the apex, which is broad and notched in the centre. The salivary duct runs along the whole length and opens near the extremity (text-fig. 6).

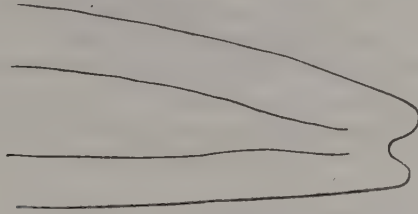


Fig. 6. Apex of hypopharynx of ♀ from ventral aspect; greatly enlarged.

(5). *Labium*.—The most noticeable feature of this species is the labium, which forms the long proboscis giving the insect its specific name. The organ lies ventral to all the other trophi and is loosely attached to the head, its base being enclosed in a basal membrane, the conjunctive membrane of Meinert (10). The labium extends directly forwards in front of the head, and is grooved on its dorsal surface, the other mouth-parts lying within this groove. It is a rather broad organ, and stiff, its surface being strengthened at intervals by transverse bands of brown chitin. At its distal end are the two labella, each of which is so situated that it forms a right or left half of the apex of the labium. The two labella are flattened from side to



Fig. 7. One of the spine-like processes of labellum of ♀ ($\times 830$).

side, and not horizontally as in the rest of the proboscis. They are united at their bases, but are separate distally; they are convex externally and concave internally, and each contains within it a number of pseudotracheae.

The external surface of each labellum (Pl. vi, fig. 1) has a honeycombed appearance, and bears some short, fairly strong spines projecting outwards from it (text-fig. 7). As stated above, Dr. Imms has found this species only on flowers belonging either to the order Scrophulariaceae or to the Labiatae, in both of which the flowers are tubular. In view of this observation, I would suggest that the use of these spines is to steady the insect somewhat when feeding on nectar. Having inserted its

proboscis into the flower, the insect would naturally make the two labella diverge so as to suck up the nectar; this would have the effect of making the spines project into the sides of the flower and would give the insect a slightly firmer hold while it was hovering. Such an arrangement would, I think, be a help, considering the great length of the proboscis.

III. Mouth-parts of the Male.

(1). *Mandibles*.—Absent.

(2). *Maxilla* (text-fig. 8).—Differs very strikingly from the maxilla of the female in the method of its connection with the head. In the female, as stated above, the base of the maxilla is inserted well inside the head. In the male there is no articulation, but the whole organ, with its palp, lies in a membranous area situated within a hollow. The latter is formed firstly by the forward prolongation of the central anterior region of the submentum, and secondly by the hollowing out of the

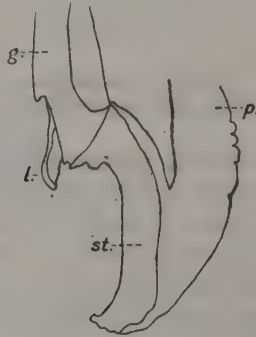


Fig. 8. Basal portion of right maxilla of ♂ ($\times 44$): *g*, galea; *l*, rudiment of lacinia; *p*, maxillary palp; *st*, stipes.

parts of the genae lying on either side of this process of the submentum. Thus it will be seen that the maxilla in the male is not nearly so firmly welded to the head as it is in the female. The maxilla consists of stipes, lacinia, galea and palp.

Cardo.—Absent.

Stipes.—A broad, very deeply chitinised rod, and slightly curved. It has a distinct articulation with the galea, and is not continuous with it as in the female. The articulation is straight, but faces obliquely towards the middle line.

Lacinia.—A small projection from the inner basal corner of the galea, slightly hooked at its extremity, and pointing towards the head. Its inner edge is stronger than the outer one, as it has a ridge running down it. A straight line, running parallel to the edge of the galea, can be seen separating it off from the latter piece.

Galea.—Approximately of the same length as in the female. It is slightly curved outwards at the base, but the remainder is straight until close to the apex, where it narrows. The inner edge commences to narrow before the outer one. The galea is more deeply chitinised at the base than elsewhere, the chitin decreasing over the

general surface to the apex, which is weak and practically colourless. There is, however, as in the female, a rod of deeper chitin going down the galea, but it gradually disappears before the apex is reached. The two galeae would, when brought together, form a circular tube of which each piece would form one side, up which the liquid food could be sucked.

The apex (fig. 9) is covered with two series of hairs, in one of which the hairs are long and point outwards and slightly forwards, those in the other (along the inner edge) being shorter and pointing inwards and more forwards. The two series

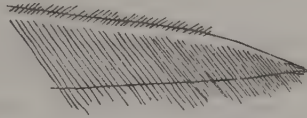


Fig. 9. Apex of right maxilla (galea) of ♂; greatly enlarged.

approximate near the apex, but are more widely separated further down. Hairs are found down to the base of the galea, but are not nearly so numerous as at the apex, and further down the blade they lie in the centre in a direction parallel with its edges.

Maxillary palp.—Of the same length as in the female, but the comparative lengths of the two joints are different, the second one being just over half as long again as the first one, instead of being only three-quarters of its length. In addition to this, the second joint is more uniform in width, ending more bluntly and not being so drawn out as in the female. There are the same different types of hairs as are found on the female's palp.

(3). *Labrum-epipharynx* (text-fig. 10).—The most essential difference between this organ and its counterpart in the female is found in the character of the apex. The

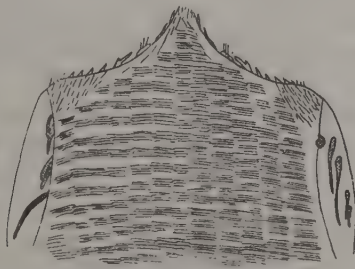


Fig. 10. Apex of labrum-epipharynx of ♂; greatly enlarged.

base of the blade is as strongly chitinated as in the female, but the rest of it has not the same strength, as the chitin decreases, the apex being only feebly chitinated. In contrast to the apex of the labrum-epipharynx in female, that of the male bears no teeth, unless some serrations along the edges can be so called. It is, however,

hairy, more pointed than in the female, and has no central strengthening rod of chitin. Its breadth is covered with rows of minute hairs or spines which lie in a direction perpendicular to the edge of the blade. On either side of the apex is an area free from hairs (fig. 10), in which lie the curved rod-like structures shown in the figure.

(4). *Hypopharynx* (text-fig. 11).—This has the apex much broader than in the female, and it ends abruptly and does not taper. The salivary duct runs down the middle and opens at a distance of '4 mm. from the apex.

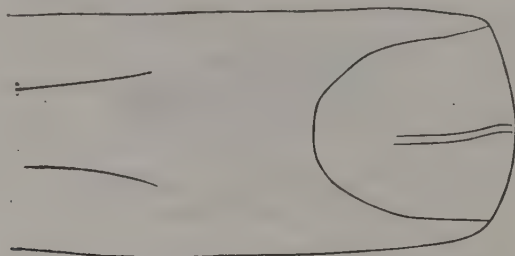


Fig. 11. Apex of hypopharynx of ♂ ; greatly enlarged.

(5). *Labium*.—Similar to that of the female, except that the teeth on the pseudo-tracheae of the labella seem to be rather more slender as a rule, but the difference is very slight.

IV. Measurements, in Millimetres, of the Mouth-parts of both Sexes.

	<i>Labium.</i>		<i>Mandibles.</i>		<i>Maxillae.</i>				<i>Hypo-pharynx.</i>		<i>Lbr-epi-pharynx.</i>		
	♂	♀	♂	♀		♂		♀		♂	♀	♂	♀
Length . . .	47	49	—	left 10	right 10	left 9.5	right 9.5	left 9.8	right 9.6	9.5	9.5	9.5	9.3
„ . . .	42.5	42	—	—	—	—	—	—	—	—	—	—	—
Greatest width	—	—	—	.53	.54	.24	.30	.35	.37	.40	.40	1.04	.66
Width in middle . .	—	—	—	.30	.30	.14	.16	.18	.13	—	.10	.58	.46

V. Conclusions as to the Feeding-habits of the Species.

From an examination of the mouth-parts of both sexes of *Pangonia longirostris* it will be seen that the sexual differences are :—

(1) That mandibles are completely absent in the male (as in all other male TABANIDÆ), but are present in the female as strong organs toothed at their apices.

(2) The maxillae of the male are loosely attached to the head, lying in a membranous area and with no articulation with the head skeleton, and are hairy to the apex ;

those in the female are firmly attached to the endo-skeleton of the head and are hairy over a portion of their length only, the apices being naked and armed with strong teeth.

(3) The labrum-epipharynx of the male has a weak chitinated apex and is hairy; in the female it has a firm apex, strengthened by a median band of chitin, and is armed with strong teeth and not hairy.

(4) The hypopharynx of the male differs from that of the female only in being broader at the apex.

(5) The labium is similar in the two sexes, and the pseudotracheal teeth are found in both male and female.

I conclude from these observations that the male could only suck blood which was flowing from a wound already present on an animal, such as might be caused by the bite of a female Tabanid. I mention this as a possibility, but do not think it is at all likely to occur, as I have been unable to find any reference to a male Tabanid sucking blood. They are always found sucking up the nectar of flowers.

The female is quite competent to suck blood, but can at any time suck up also the juices of flowers through her proboscis.

The most natural way in which the former process would be carried out seems to me to be the third of the three different methods I have enumerated above on p. 257. The female alights, punctures with her stylets and then sucks up blood through the proboscis, either while settled or on the wing. It is possible, however, that certain species feed only while hovering and others only when settled on the skin, but further observations are greatly needed.

The idea that *Pangonia longirostris* could pierce the skin with its proboscis seems to me quite untenable, as the apex of this organ is not pointed and could only be thrust into anything by the close apposition of the two labella. In this case, all possible value that the pseudotracheal teeth might have as piercing organs would be lost, seeing that they would be enclosed inside the labella. There are, too, some short but rather stout spines projecting outwards from the outer edge of the labella, which would hinder any attempt to thrust in the proboscis. As pseudotracheal teeth are found on the labella of such a purely flower-haunting family as the Bombyliidae, and as they are also present in the male *P. longirostris*, I do not consider that their presence has any significance in deciding whether an insect is a blood-sucker or not. According to Dimmock (4) the Bombyliidae use these teeth to scratch the surface of flowers, and no doubt their presence in *Pangonia* can be explained in the same way.

Dr. Imms states that in the living insect the apex of the proboscis is flexible and has not the rigidity usually associated with piercing organs.

VI. Comparison of the Mouth-parts with those of other Tabanidae.

The other TABANIDAE with which *Pangonia longirostris* will be compared are species of *Tabanus*, *Chrysops*, *Haematopota*, and other species of *Pangonia*. The only literature that I have found which deals with the mouth-parts of the males of this family are the writings of Hansen (7), Meinert (10), both of whom give figures of various TABANIDAE, and Wesche (18), who gives a figure of a male *Pangonia*

longirostris without any description. For the mouth-parts of the female I have used a mounted preparation of *Chrysops coecutiens*, and consulted the figures and descriptions of Hansen (7), Meinert (10), Patton and Cragg (13), Cragg (3), and Alcock (1).

Mouth-parts of the Female.

The apices of the mandible of *Pangonia longirostris*, in common with those of *P. sorbens* and *P. depressa*, as figured by Hansen (7), differ from those of species of *Tabanus*, *Chrysops*, and *Haematopota*, in having teeth on both edges of the blade. In *Tabanus* all the teeth are very small and directed backwards, in *Haematopota* there is "a regular row of extremely fine serrations" (Cragg, 3), and in *Chrysops coecutiens* there are a number of large teeth followed by smaller ones; in all these three genera teeth are found only on the inner edge of the blade.

The apices of the maxillae of *Tabanus* are armed with stout rasp-like teeth which are set closely together on the whole of the surface. These teeth continue for some distance on the inner side, and all point towards the base of the blade. In *Chrysops coecutiens* the apical teeth are not so numerous as in *Pangonia longirostris*, but teeth are found further down the blade than in the latter species.

In the maxillary palp of *Tabanus*, *Chrysops* and *Haematopota* the second joint is larger or much larger than the first, but in the female of *Pangonia longirostris* it is smaller, and larger in the male.

The apex of the labrum-epipharynx in *Pangonia longirostris* differs from the condition found in *Tabanus*, *Chrysops* or *Haematopota*. In these three genera teeth are found only at the extreme apex, which is more strongly chitinated than the rest of the blade, and in none of them do they occur so far down. In the case of *Chrysops coecutiens* no hairs are found on the labrum-epipharynx as in *P. longirostris*, though they occur in *Tabanus sudeticus*.

The hypopharynx does not differ from that found in other TABANIDÆ.

The labium is considerably more elongate than in *Tabanus*, *Haematopota* or *Chrysops*.

The mouth-parts of the female resemble those found in *Tabanus* more closely than they do those of *Chrysops* or *Haematopota*.

References.

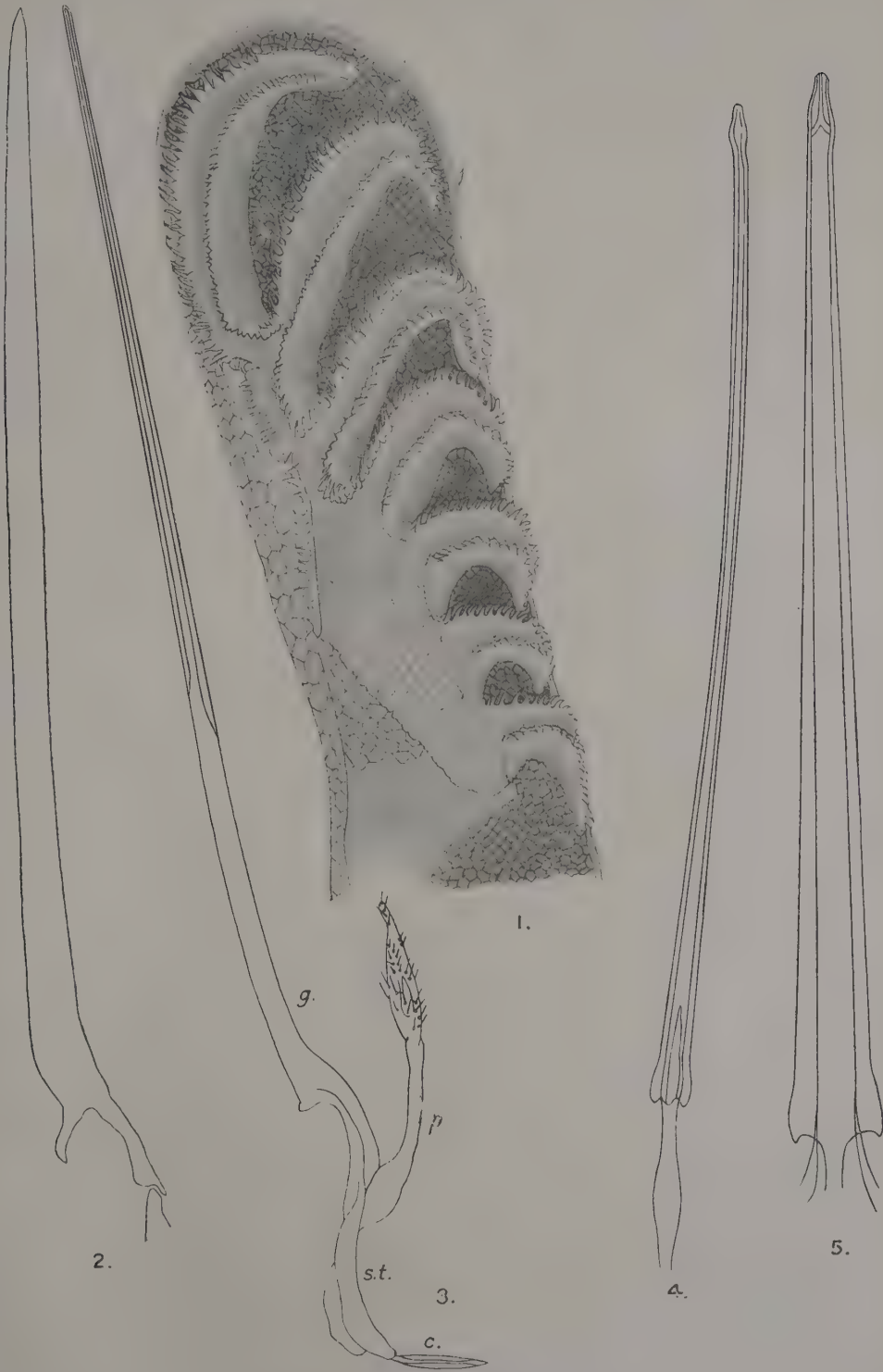
1. Alcock, A. . . . Entomology for Medical Officers. London, 1911.
2. Austen, E. E. . . African Blood-sucking Flies other than Mosquitoes and Tsetse-flies. British Museum, 1909.
3. Cragg, F. W. . . Structure of *Haematopota pluvialis*.—Sci. Mem. Med. and Sanit. Depts. Govt. India, no. 55, Calcutta, 1912.
4. Dimmock, G. . . Anatomy of the Mouth-parts and of the Sucking-apparatus of some Diptera. Boston, 1881.
5. Fantham, H. B.,
Stephens, J. W. W.
& Theobald, F. V. . . The Animal Parasites of Man. London, 1916.
6. Grünberg, K. . . Die blutsaugenden Dipteren. Jena, 1907.

7. Hansen, H. J. .. Fabrica Oris Dipteriorum. Copenhagen, 1883.
 8. Hardwicke, T. .. Transactions of the Linnaean Society, xiv, 1825.
 9. Lefroy, H. M. &
Howlett, F. W. .. Indian Insect Life. Calcutta, 1909.
 10. Meinert, F. .. Fluernes Munddele (Trophii Dipteriorum). Copenhagen, 1881.
 11. Neave, S. A. .. The Tabanidae of Southern Nyassaland.—Bull. Ent. Res., v, 1914–15, p. 294.
 12. Old, J. E. S. .. Contribution to the Study of Trypanosomiasis and to the Geographical Distribution of some Blood-sucking Insects, &c.—Journ. Trop. Med. & Hyg., xii, 1909, p. 20.
 13. Patton, W. S. &
Cragg, F. W. .. Medical Entomology. Calcutta, 1912.
 14. Roder, H. ¹ .. Stettiner entom. Zeit., xlii, 1881, pp. 384–6. *von*
 15. Roubaud, E. .. Contribution à la biologie de *Pangonia*.—Bull. Soc. Ent. France, 1912, p. 183.
 16. Sharp, D. .. Cambridge Natural History ; Insects, Pt. ii. London, 1909.
 17. Smith, J. B. .. A Contribution towards the Knowledge of the Mouth-parts of Diptera.—Trans. Amer. Ent. Soc., xvii, 1890, pp. 319–39.
 18. Wesché, W. .. Undescribed Palpi on the Proboscis of some Dipterous Flies, with Remarks on the Mouth-parts in several Families.—Journ. Roy. Micros. Soc., 1902, pp. 412–416.
 19. Wesché, W. .. Comparative Anatomy of Trophi of Diptera, and their Bearing on Classification.—Ibid., 1904, pp. 28–47.
 20. Westwood, J. O. .. An Introduction to the Modern Classification of Insects, vol. ii. London, 1840.
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EXPLANATION OF PLATE VI.

Mouth-parts of the female of *Pangonia longirostris*.

- Fig. 1. Apex of the left labellum seen from the inner side. $\times 180$.
2. Left mandible. $\times 22$.
3. Left maxilla : *c*, cardo ; *g*, galea ; *p*, palp ; *st*, stipes. $\times 22$.
4. Hypopharynx. $\times 22$.
5. Labrum-epipharynx. $\times 22$.
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Mouth-parts of *Pangonia longirostris*, Hardw.

A NEW WEEVIL PEST OF SWEET POTATOES IN JAMAICA.

By GUY A. K. MARSHALL, D.Sc.

The Imperial Bureau of Entomology has recently received from Mr. A. H. Ritchie, Government Entomologist in Jamaica, specimens of a weevil which he found to be doing serious injury to the tubers of a crop of sweet potatoes. The insect belongs to the sub-family CRYPTORRHYNCHINAE and proves to be an undescribed species of the genus *Palaeopus*, Fst. (Stett. Ent. Zeit., 1896, p. 51 & 60).

Palaeopus costicollis, sp. nov.

♂ ♀. Colour uniform dull black, clothed with erect stiff scale-like setae, which are dark brown on the prothorax (paler along the extreme front margin) and dark or light brown (irregularly intermingled) on the elytra; unevenly scattered on the latter are also a few elongate recumbent whitish scales, and there is a spot in the middle of the base of the prothorax formed of similar scales.

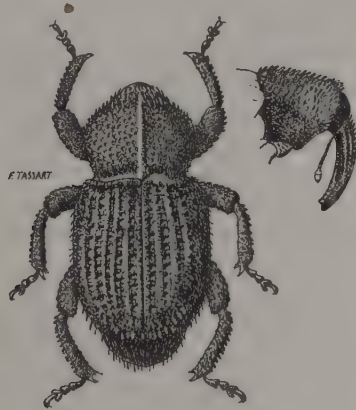


Fig. 1. *Palaeopus costicollis*,
Marshall, sp. n., ♂.

Head regularly convex above the eyes and without any anterior depression, very finely aciculate throughout and with a few scattered and very shallow punctures. *Rostrum* rather densely clothed at the base with short erect light brown setae; in the ♂, opaque and distinctly tricarinate to beyond the middle, the apical third more shiny and closely and coarsely punctate, except along a smooth median line, which bears a short central stria; in the ♀, the opaque area is confined to the basal third and the carinae are less distinct, while the apical two-thirds is more shiny and rather less coarsely punctate. *Antennae* testaceous; the funicle with joint 1 as long as

but much broader than 2,* the remaining joints very slightly widening outwardly, 3 a little longer than 4, 4 to 6 subequal and about as long as broad, 7 slightly transverse. *Prothorax* somewhat broader than long, the sides strongly rounded, broadest before the middle, deeply constricted quite close to the apex, the base shallowly bisinuate; the actual basal margin is sunk considerably below the general level of the prothorax, except in the middle, where the central costa projects backwards as short sharp process; the whole upper surface covered with large reticulated punctures, except along the middle line, where there is a conspicuous smooth ridge. *Elytra* broadly ovate, the sides slightly rounded, broadest before the middle, the basal margin distinctly broader than that of the prothorax, its external angles projecting slightly forwards, the apices jointly rounded; the dorsal outline quite flat for more than three-fifths of its length, the apical declivity steep; the striae broad and very shallow, containing large punctures, the interspaces between which are hardly lower than the longitudinal intervals, the latter not broader than the punctures, nearly flat, minutely scratched and without granules; the abbreviated tenth stria very indistinct. *Legs* short, broad and compressed; femora with fairly dense recumbent scale-like setae and shallowly furrowed beneath, the hind pair extending to the end of the fourth ventral segment; the tibiae with dense erect scale-like setae, especially along the carinate dorsal edge, but with a bare space on the apical two-thirds of the posterior face to accommodate the tarsus when folded back, and a pad of golden-brown hairs at the apex of the anterior face, the dorsal carina being simple and not angulate. *Abdomen* with erect pale setae on the ventral surface; in the ♂, the first ventral segment with a very large shallow median impression, an impunctate strip along the basal margin and the apical margin raised above the second segment, which is not longer than the third; in the ♀, the first ventral segment not impressed, punctate right up to the base, and its apical margin not raised, the second segment almost as long as the third and fourth together, the retractile eighth tergite long and narrowed, its apex armed with four well-marked teeth, the outer incisions between them being deeper than the central one. *Length*, 4 mm.; *breadth*, 2 mm.

Types, ♂ ♀, in the British Museum.

Faust has described his two species as having shoulders to the elytra; but he often used the word laxly to indicate that the basal angles of the elytra project beyond those of the prothorax, and the true humeral prominence, which indicates the presence of functional wings, is not present, all these species being wingless.

Mr. Ritchie states that the damage done to sweet potatoes by this weevil is quite similar to that inflicted by the common West Indian pest, *Euscepes batatae*, Waterh., locally known as the "scarabee." As the two insects would almost certainly be confused by untrained observers, it seems very probable, as he suggests, that some of the injury attributed to the *Euscepes* has been really due to the *Palaeopus*.

In the British Museum collection I have found two other specimens of this genus, one coming from St. Vincent and the other from Grenada. These are specifically distinct from the Jamaican species and from each other, and as it is quite likely that they will prove to have similar habits, they are described below.

* In his generic diagnosis Faust states that joint 1 is longer than 2; but I have examined cotypes of both his species, in which these joints appear to me to be equal.

***Palaeopus grenadensis*, sp. nov.**

Extremely similar in general appearance to *P. costicollis*, but differing in the following particulars:—

♂. *Head* with a shallow semicircular impression in front, the floor of which is opaque and uneven like the base of the rostrum, the rest of the head smooth, shiny and impunctate. *Rostrum* with the basal carinae indistinct, the apical area much less coarsely punctured, and the central stria scarcely perceptible. *Prothorax* relatively a little longer, almost as long as broad, and without any central costa, the anterior constriction much more shallow, the setae much narrower, and the punctures on the side of the prosternum markedly coarser. *Elytra* slightly narrower proportionately, with larger punctures, the tenth stria entirely lacking; the dorsal outline flat only to the middle, thence sloping backwards, so that the posterior declivity is much less steep. *Legs* much more slender, the femora not compressed, the setae on the latter suberect and not recumbent, those on the tibiae much more slender than in *P. costicollis*, about half the width. *Length*, $3\frac{1}{4}$ mm.; *breadth*, $1\frac{1}{2}$ mm.

GRENADA: Balthazar, windward side (*H. H. Smith*).

***Palaeopus subgranulatus*, sp. nov.**

Also very similar superficially to *P. costicollis*, and to be distinguished as follows:—

Head and *rostrum* as in *P. grenadensis*. *Prothorax* broader than in either species and without any central costa, markedly more convex longitudinally, the greatest depth being not far from the base. *Elytra* not striate on the disc, but with rows of very shallow and often ill-defined punctures, each of which bears at its anterior end a small overhanging granule; on the inflexed margins there are no granules, and the punctures form two shallow striae, the abbreviated tenth stria being entirely absent; the dorsal outline not flat, but sloping upwards from the base to about the middle, the posterior declivity being longer and more gradual than in either of the other species. *Legs* similar to those of *P. grenadensis*, but stouter and the setae on the tibiae almost as broad as those of *P. costicollis*. *Length*, 4 mm.; *breadth*, 2 mm.

ST. VINCENT (*H. H. Smith*).

Faust's two species, *P. adspersus* and *P. laticollis*, were described from Venezuela, and nothing is known with regard to their habits. The following key may assist in the discrimination of the five known species of the genus:—

- 1 (8). Front portion of the head with a shallowly impressed semicircular rugose area; prothorax without any central costa.
- 2 (5). Head distinctly sculptured above the impression; the dorsal carinae on the tibiae sharply angulated close to the base; the elytra with an abbreviated tenth stria.
- 3 (4). Vertex of head coarsely punctate; prothorax somewhat broader than long; metasternum not tuberculate *adspersus*, Fst.
- 4 (3). Vertex of head transversely striate; prothorax much broader than long; metasternum with a tubercle projecting over the hind coxa on each side *laticollis*, Fst.
- 5 (2). Head quite smooth and impunctate above the semicircular area; the dorsal carina on the tibiae simple; elytra without any tenth stria.

- 6 (7). Prothorax much broader than long (10 : 15); elytra with a minute smooth granule at the anterior edge of each puncture .. *subgranulatus*, sp. n.
- 7 (6). Prothorax nearly as long as broad (9 : 10); elytra without granules *grenadensis*, sp. n.
- 8 (1). The whole of the head above the eyes evenly convex and smooth, with only a few scattered shallow punctures; prothorax with a conspicuous raised central costa *costicollis*, sp. n.
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AFRICAN APHIDIDAE—PART III.*

By FRED. V. THEOBALD, M.A.

The following are some new species of APHIDIDAE found in Africa. The majority are from the collection sent me by Mr. F. C. Willcocks, Entomologist to the Sultanic Agricultural Society of Egypt. Others have been received by the Imperial Bureau of Entomology.

Four previously described species are added, so as to keep these lists complete :—

1. *Macrosiphum dahliafolii*, nov. sp.
2. *Aphis durantae*, sp. nov.
3. *Aphis zizyphi*, sp. nov.
4. *Aphis ficus*, sp. nov.
5. *Aphis tamaricis*, sp. nov.
6. *Aphis bauhiniae*, sp. nov.
7. *Aphis buddleiae*, sp. nov.
8. *Aphis mathiolae*, sp. nov.
9. *Aphis mathiolellae*, sp. nov.
10. *Aphis pruniella*, sp. nov.
11. *Aphis pomonella*, Theobald.
12. *Aphis pheidole*, Theobald.
13. *Aphis acetosae*, Koch.
14. *Siphocoryne pseudobrassicae*, Davis.
15. *Hyalopterus insignis*, sp. nov.
16. *Myzus pterisoides*, sp. nov.

1. ***Macrosiphum dahliafolii***, sp. nov. (fig. 1).

Apterous viviparous female.—Apparently deep reddish, with black tubercles on the body; black cornicles and cauda; black antennae, except for base of third segment. Legs apparently yellowish-red, but the femora black, except just at base, a small dark area at base of tibiae, a large apical one and black tarsi. Eyes deep blackish-red. Antennae longer than body, arising from prominent frontal tubercles; basal segment much larger than second; both deep black, with a few hairs; third segment about as long as sixth and longer than fourth, with 56–68 round sensoria, evenly distributed over its whole length, except just at the pale base and apex; fourth longer than fifth; sixth not quite as long as 4 + 5, its basal area short; sixth segment paler than third; in some the flagellum is quite pale; third to fifth imbricated; sixth markedly so; a few stiff hairs on third to fifth. Some of the frontal hairs slightly capitate. Rostrum reaching nearly to the third coxae; apical segment longer and narrower than the penultimate; apex black. The black cornicles are cylindrical, slightly expanding basally; broad and a little

* Part I—Bull. Ent. Res., iv, pp. 313–337; Part II—Bull. Ent. Res., vi, pp. 103–153.
(C419)

shorter than the third antennal segment, in some about as long; the apex markedly reticulate, remainder imbricated. The black cauda is about half the length of the cornicles, acuminate, spinose; the spines in rows, longish and thorn-like; five pairs of lateral chaetae of pale colour; cauda about level with apex of cornicles. Anal plate black, spinose, with a few long hairs. Abdomen with stiff moderately

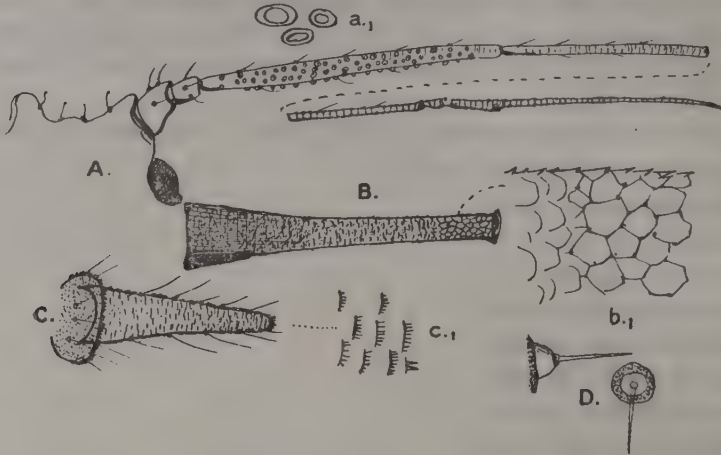


Fig. 1. *Macrosiphum dahliaefolii*, sp. n., apterous ♀: A, head and antenna; a, sensoria; B, cornicle; b, apical sculpturing; C, cauda; c, apical sculpturing; D, body hairs.

long pale hairs, some slightly capitate, arising from dark mammillae; the lateral edges of the abdomen in places have very short, fine spines. Legs with long, pale, thorn-like hairs, a few being capitate. The dark spots on the body are darkened areas around the base of the hairs. Length, 2 mm.

UGANDA: Kampala, 19.xii.16 (C. C. Gowdey).

Food-plant.—Dahlias.

Described from a number of apterous viviparous females sent in spirit, but with no colour notes; the colour seems however to have been more or less retained and appears to be a rich reddish, with marked black abdominal spots. In general appearance it approaches the European *M. solidaginis*, but the structure of its antennae and cornicles is quite different. The only known species feeding on dahlias is *Aphis rumicis* (*A. dahliae*, Westwood). In some specimens the proboscis reaches well up to and even slightly beyond the third coxae and the cornicles vary in thickness and relative lengths. It feeds on the leaves of the dahlias.

2. *Aphis durantae*, sp. nov. (fig. 2).

Apterous viviparous female.—Very small (·7 to ·9 mm.). Greenish to yellowish tinged with green; two conspicuous dusky areas on the head; eyes black. Antennae with the two basal segments dusky; third paler; fourth smoky; fifth dusky to black. Cornicles dusky to black. Cauda shaded. Legs obscure ochreous; tibiae dusky at apex; tarsi black. Antennae not quite half the length of the body; basal

segment wider than second, but no longer; third longer than fourth; fourth and fifth about equal in length; sixth about as long as fourth and fifth, its basal area more than half the length of the flagellum, but slightly shorter than the fifth. A small papilla on each side of the prothorax and two small lateral abdominal ones before the cornicles. Cornicles rather short and thick, expanding basally (some more so than in others), faintly imbricated. Cauda not quite as long as the cornicles,

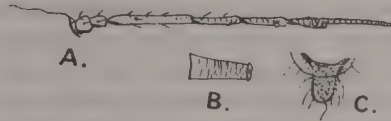


Fig. 2. *Aphis durantae*, sp. n., apterous ♀: A, Head and antenna; B, cornicle; C, cauda.

bluntly acuminate, with three pairs of lateral and one subapical hair. Anal plate somewhat darkened, with a few apical hairs. Proboscis reaching past the base of the second pair of legs; dusky at apex; apical segment narrower and longer than the penultimate. Length, 7–9 mm.

EGYPT: Ghezireh, 31.iii.1910 and 1913 (F. C. Willcocks).

Food-plant.—*Duranta*.

This very small *Aphis*, according to Mr. Willcocks, lives on the main and secondary veins, chiefly on the upper surface of the leaves of the *Duranta*. It occurs, he says, in small numbers only.

Described from about 20 apterous females in conjunction with original colour notes, sent by Mr. Willcocks.

3. *Aphis zizyphi*, sp. nov. (fig. 3).

Alate viviparous female.—Very dark olivaceous to brownish black. Eyes dark brown. Antennae with the two basal segments olivaceous to dusky; third with basal half olivaceous, remainder dusky; fourth, fifth or sixth black. Prothorax green with blackish prothoracic collar (with a shade of obscure brown in it).

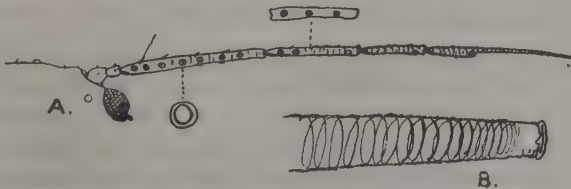


Fig. 3. *Aphis zizyphi*, sp. n., alate viviparous ♀: A, head and antenna; B, cornicle.

Thoracic lobes black. Abdomen apple-green. Cornicles faintly dusky to dusky green. Cauda greenish, with base and apex faintly dusky. Wing insertions green; cubital vein green; stigma smoky; costa and veins dusky. The green abdomen has three dark lateral spots between its base and the base of the cornicles. Legs

with femora of first and second pairs greenish ochreous; tibiae ochreous, dark at apex; tarsi dark; hind femora with apical half dusky; tibiae as in the anterior legs. Antennae not as long as the body; first segment larger than second; third about as long as the sixth, with 7-8 circular sensoria; fourth longer than fifth, with 3-4 sensoria; fifth with normal subapical sensorium; basal area of sixth half the length of the flagellum; the usual sensoria at apex of basal half; all the segments imbricated. Proboscis reaching to third pair of legs; acuminate. There are lateral abdominal papillae, one pair caudad of the cornicles and two pairs close together cephalad of them. Cauda as long as cornicles, spinose, with three pairs of lateral hairs, the apical pair curved inwards. Anal plate spinose, with a few long apical hairs. Cornicles rather short, slightly expanding basally, apparently spirally ringed up to nearly the apex, which is unadorned. Legs normal, with a few short hairs on the tibiae. *Length*, 1.8-2 mm.

Apterous viviparous female.—Yellowish green, mottled with darker shades of green. Antennae of the same colour as the head, but apex of fifth and whole of sixth segments are dusky. Eyes dark reddish-brown. Cornicles yellowish green, dusky at apex. Legs yellowish green; tibiae with apices shaded; tarsi dark. Cauda yellowish green. Antennae shorter than body; basal segment larger than second; third longer than fourth and about as long as sixth; fourth longer than fifth; basal area of sixth half the length of the flagellum; sensoria on fifth and sixth normal. Cornicles moderate in size, slightly expanding basally, imbricated. Cauda nearly as long as the cornicles, spinose, with three pairs of lateral hairs, the apical pair curved inwards. A large lateral papilla between the prothoracic and mesothoracic legs. *Length*, 1.5-2 mm.

EGYPT: Gizeh, 31.xi.10 (F. C. Willcocks).

Food-plant.—*Zizyphus spina-christi*.

Mr. Willcocks found this species swarming on the end portions of the young shoots of *Zizyphus* which had grown up from the base of the trunk and also on any young growth on the trees.

Zizyphus is a genus of the *Rhamnaceae* or buckthorn tribe. *Zizyphus spina-christi* occurs in Asia and North Africa, including Egypt.

4. *Aphis ficus*, sp. nov. (fig. 4).

Apterous viviparous female.—Head, thorax and abdomen a pale bright apple-green. Eyes very dark red to reddish brown. Antennae with the first and second segments of the same colour as the head; the third to fifth segments pale; the sixth smoky. Legs very pale yellowish or yellowish green; tarsi and tips of the tibiae shaded dusky. Cornicles of the same colour as the body, but the tips smoky. Cauda yellowish green. Antennae not so long as the body; the first segment larger than the second; the third longer than the fourth, about as long as the sixth; fourth and fifth about equal in length; the fifth with the usual subapical sensorium; basal area of the sixth about one-third the length of the flagellum. Cornicles more or less cylindrical, with irregular transverse striae, showing a dotted appearance. Cauda about as long as the cornicles, spinose, with three pairs of lateral hairs. Anal plate spinose, with some long apical hairs. *Length*, 1.8-2 mm.

Alate viviparous female.—Head olivaceous; eyes red. Antennae with first and second segments olivaceous; third to sixth dusky. Prothorax greenish; collar olivaceous. Meso- and meta-notum olivaceous, with dark lobes, but ground-colour paler than head. Abdomen apple-green. Cornicles dusky. Cauda green. Legs with tarsi of first and second pairs ochreous; tips of tibiae dusky; third pair same as former, but the femora are shaded. Wings with pale or faintly greenish insertions; costa faintly smoky; cubitus greenish, very pale; stigma faintly smoky; oblique vein pale dusky. Antennae shorter than the body; first segment larger than the second; third longer than fourth; fourth and fifth about equal; the third with seven circular sensoria; the fourth with one apical sensorium, as has also the fifth; sixth with basal area one-third to one-half the length of the flagellum. Cornicles more or less cylindrical, with faint dotted transverse lines. Cauda as long as the cornicles; with three pairs of lateral hairs; spinose. Anal plate spinose, with a few apical long hairs. *Length*, 1·8–2 mm.



Fig. 4. *Aphis ficus*, sp. n.: A, head and antenna of alate ♀; a, cornicle; B, head and antenna of apterous ♀; b, cornicles; C, wing of alate viviparous ♀.

Nymph.—Head pale olive-green, slightly farinose; eyes dusky brown. Antennae with first two segments olive-green; third to fifth pale; sixth smoky. Prothorax pale olive-green, farinose. Meso- and meta-notum a pale ill-defined yellowish-brown; base of the wing-buds very pale greyish-green; tips of wing-buds dusky. Abdomen pale yellowish-brown, suffused with green around the cornicles. Cornicles dusky. Cauda of the same colour as the abdomen. Legs yellowish; tips of the tibiae and all the tarsi dusky.

EGYPT: Gizeh, Cairo, 6.vi.14 (F. C. Willcocks). UGANDA: Kampala, 2.i.16 (C. C. Gowdey).

Food-plant.—Sycomore fig (*Ficus sycomorus*).

Described from a number of spirit specimens sent me by Mr. Willcocks, with colour notes from the live insects. It occurs in great numbers on the leaves of the sycomore fig tree, especially on the leaves which have been attacked by the Sycomore Fig Tree *Psylla*. These Aphids live in the empty pits left by the *Psyllae*. This insect bears some resemblance to *Aphis zizyphi*, but is apparently distinct, for the fourth antennal segment in the alate female has only one sensorium, not 3 to 4 as in *zizyphi*, and the cornicles of the alatae do not show the marked spiral ornamentation seen in the *Zizyphus* feeder.

Specimens sent to the Imperial Bureau of Entomology by Mr. Gowdey from *Ficus sycomorus* at Kampala are clearly the same insect, although the cornicles seem darker.

5. *Aphis tamaricis*, sp. nov. (fig. 5).

Alate viviparous female.—Greenish, with dark thoracic lobes. Head almost flat in front, or slightly rounded, broad. Antennae about half the length of the body, greenish; first segment a little wider than second; third longer than fourth and sometimes slightly longer than sixth, with 2–3 rather large circular sensoria; fourth often with a single sensorium, as long as fifth, the latter with an irregular subapical sensorium and often another placed medially; the sixth very marked, the basal area being longer than the small blunt flagellum; normal sensoria at junction of basal area and flagellum; third to sixth segments imbricated. Eyes large.

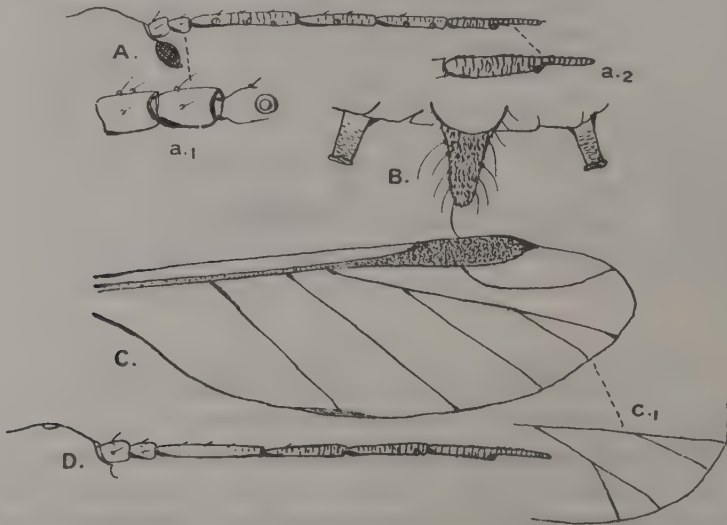


Fig. 5. *Aphis tamaricis*, sp. n. : A, head and antenna of alate ♀; a, a₂, segments of antenna; B, cauda and cornicles; C, anterior wing; c₁, variation in venation; D, head and antenna of apterous ♀.

Proboscis reaching to base or just past the base of the second coxae. Thorax broad. Abdomen somewhat rounded. Cornicles rather short and thick; cylindrical, slightly expanding basally; green, dusky at apex, not so long as cauda, apex broad; slightly imbricated. Cauda green, spinose at the edges, less so on surface, broadened at base, with four pairs of lateral hairs, the last pair more or less curved inwards at the tips and arising from prominent mammillae; apex pale, bluntly acuminate. Anal plate green. Legs green, normal; a few hairs on the tibiae. Wings much longer than body; slightly tinted. (In some specimens the venation is abnormal.) Length, 1–1.3 mm.

Apterous viviparous female.—Green, somewhat mottled and often darkened in the middle; with five to six small black lateral specks. Head flat to slightly rounded and broad in front. Antennae shorter than body; first segment wider than

second; third longer than fourth and a little shorter than sixth; fourth a little longer than fifth; sixth with basal area nearly twice as long as the short blunt nail-like flagellum; sensoria on fifth and sixth normal; third to sixth imbricated. Eyes large. Proboscis reaches to second coxae. A marked papilla on each side between meso- and meta-thoracic legs and two (?) pairs of lateral abdominal papillae. Cornicles dark green, thick, rather short, slightly expanding basally, broad at apex; showing very faint imbrication; not quite so long as the cauda. Cauda dark green, acuminate, spinose, with four pairs of lateral hairs, the apical pair curved inwards, at some little distance from apex and arising from marked tubercles. Anal plate small. Legs rather thick; tarsi and apices of tibiae darkened; tibiae with a few short hairs. In some the cornicles are thicker and shorter than in others and consequently much shorter than the cauda. Four short hairs on the frons. *Length*, 1.1–2 mm.

EGYPT: Ghizeh, 26.v.10 (*F. C. Willcocks*).

Food-plant.—*Tamarix* sp.

Described from a number of apterous and two alate females preserved in spirit. The specimens had retained a more or less greenish hue, but definite colours cannot be given. It is a very marked species, however, easily distinguished by the structure of the antennae, especially by the shortness of the flagellum and by the small number of sensoria on the third antennal segment of the alate female. Wing venation very erratic. Cauda long compared with the rather short, thick cornicles. The only species recorded from this plant.

6. *Aphis bauhiniæ*, sp. nov. (fig. 6).

Alate viviparous female.—Head dark brown; thoracic lobes black; rest of body green. Sternal thoracic plates black. Proboscis pale. The green abdomen is darkened in the middle and has three pairs of black lateral spots. Cornicles brown. Cauda pale. Antennae pale, except just at the apex. Fore and mid femora pale; hind pair dusky; apices of tibiae and tarsi dark. Antennae not so long as the body; first segment a little wider than second; third longer than fourth, but shorter than sixth, with four to seven round sensoria, more or less equally separated; fourth segment of about the same length as fifth; sixth longer than four and five, its basal area rather less than one-third the length of the flagellum; third to sixth imbricated. Head rather flattened in front. Eyes large. Proboscis reaches to the second coxae; apical segment longer than the penultimate. Cornicles longer than cauda, slightly widened basally; imbricated. Cauda projecting well beyond the cornicles, spinose, with three pairs of lateral hairs. Anal plate spinose, with a few long apical hairs. A papilla on each side of pronotum; also one between the meso- and meta-thoracic legs and some on abdomen. Wing veins rather pale. *Length*, 1.1–1.5 mm.

Apterous viviparous female.—Green and mottled green. Cornicles dark greenish-brown. Cauda greenish, somewhat darker than body; apex of antennae dusky, also apex of tibiae and the tarsi dark. Antennae not quite so long as the body; basal segment wider than the second; third a little longer than fourth; not so long as the sixth; fourth and fifth equal; apex of fifth and all the sixth darkened;

basal area of sixth about one-third the length of the flagellum; third to sixth imbricated. Cornicles rather long, thick and dark; cylindrical, but expanding basally; imbricated; projecting beyond the tip of the cauda and nearly twice its length and longer than the third antennal segment. Cauda spinose, with three pairs of lateral hairs, placed on its apical half. Anal plate darker than the cauda; spinose and with a few long apical hairs. A papilla on each side of pronotum and one on each side of body between the meso- and meta-thoracic legs. Proboscis narrow.

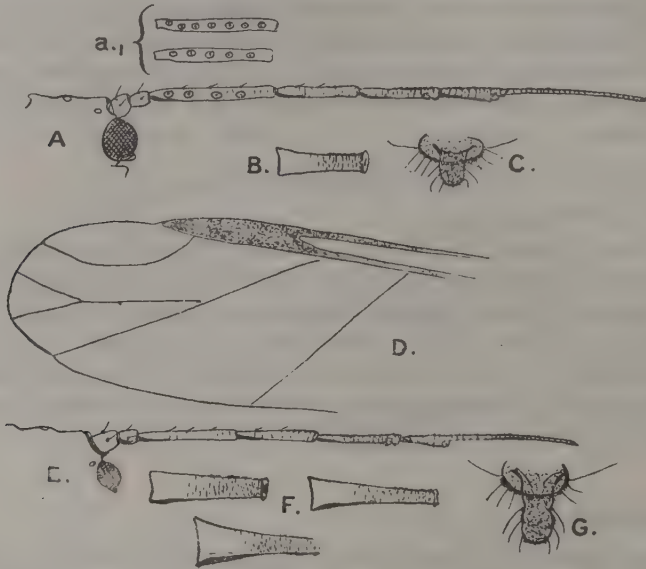


Fig. 6. *Aphis bauhiniae*, sp. n.: A, head and antenna of alate ♀; a, variations of sensoria on third antennal segment; B, cornicle; C, cauda; D, anterior wing; E, head and antenna of apterous ♀; F, variations of the cornicle; G, cauda.

reaching past the second pair of legs, often nearly to the third; acuminate; apical segment narrower and longer than the penultimate. Legs normal; tibiae with a few scattered hairs. Length, 1-1.4 mm.

EGYPT: Gizeh, 26.v.10 (F. C. Willcocks).

Food-plant.—*Bauhinia*.

Described from a number of apterous and alate females taken by Mr. Willcocks on the leaves of a *Bauhinia*, preserved in spirit, but still showing faint colours. The structure of the antennae in the alate female will at once separate it from other Egyptian species.

There appears to be some variation in the shape of the head in front, some mounts showing it to be quite flat, whilst in others it is slightly projecting in the middle and at the sides; and the number of antennal sensoria vary, four being the fewest and seven the most I have seen on the third segment.

7. *Aphis buddleiae*, sp. nov. (fig. 7).

Alate viviparous female.—Head dusky, tinged with olivaceous; eyes black. Antennae shorter than body; first and second segments pale, olivaceous; third dusky, pale at the base; fourth to sixth dusky; first segment a little larger than second; third a little longer than fourth and shorter than sixth, with 14–16 round sensoria of varied sizes; fourth as long as the fifth, with 3–5 round sensoria; sixth as long as 4 + 5, its basal area slightly less than half the length of the flagellum; third to sixth imbricated; the whole of the antennae are rather thick. Proboscis long, reaching well past third coxae; acuminate; the apical segment narrow, about twice as long as the penultimate. Pronotum lemon-yellow, dusky in front. Thoracic lobes brownish black to deep blackish-brown. Abdomen lemon-yellow; skin reticulate. Cornicles black, about as long as third antennal segment; cylindrical, but slightly swollen on the inner side near apex or base, or irregularly imbricated. Cauda lemon-yellow, with dusky apex to faintly smoky; rather short and triangular;

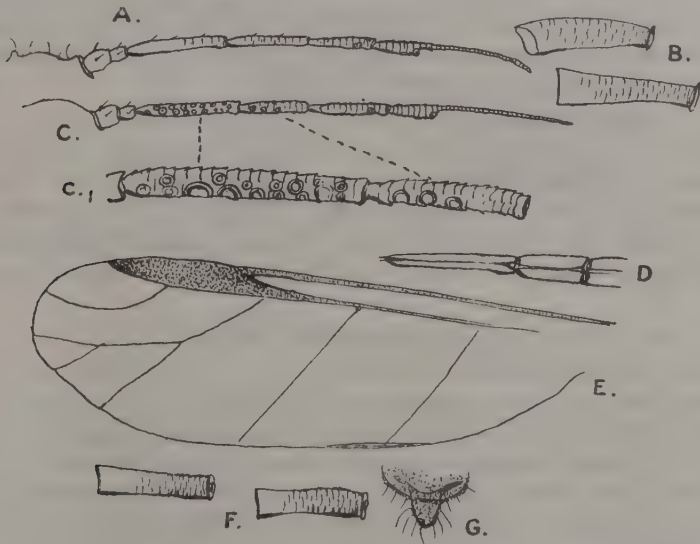


Fig. 7. *Aphis buddleiae*, sp. n.: A, head and antenna of apterous ♀; B, cornicles; C, head and antenna of alate ♀; D, apex of proboscis; E, anterior wing; F, cornicles; G, cauda.

about one-third the length of cornicles, and projecting beyond them; spinose, with three pairs of pale lateral hairs and one dorsal subapical one. Anal plate smoky; spinose, with a few long pale hairs. In front of the cornicles on each side of the abdomen are three pale dusky spots and one at the base of each cornicle, and two pale dusky bands across the apical segments of the abdomen. Legs long and rather thin; first pair with femora and tibiae pale ochreous; apex of tibiae and the tarsi dusky; the second have also the apex of the femora dusky, and the third pair the same. Wings with yellowish insertions; cubital vein yellow; costa yellowish; stigma pale and ill-defined, yellowish to ochreous smoky; lower margin somewhat greenish. *Length*, 1.3 to 1.5 mm.

Apterous viviparous female.—Bright lemon-yellow, slightly mealy, with black cornicles. Head lemon-yellow; eyes black. Antennae shorter than the body; first and second segments lemon-yellow; third and fourth paler; fifth pale, with smoky apex; sixth smoky; the first a little wider than second; the third longer than fourth, not quite so long as the sixth; fourth about as long as the fifth; the basal area of sixth about one-third the length of the flagellum; third to sixth faintly imbricated. Proboscis long, reaching past the third pair of legs, pale, acuminate; the apical segment rather narrow, about twice as long as the penultimate. Thorax and abdomen lemon-yellow. Cornicles dull black, thick, somewhat expanding basally, a little longer than the third antennal segment; curved outward; imbricated; variable in thickness, some being very much thicker than others, reaching about to the level of the cauda. Cauda shaded to dusky; much shorter than cornicles; almost triangular; slightly spinose, with three pairs of lateral hairs and one or two subapical dorsal curved ones. Legs moderately long and thin; femora lemon-yellow; tibiae pale, with dusky apex; tarsi dusky; coxae and trochantas lemon-yellow. Venter lemon-yellow. A pale papilla on each side of pronotum; one between the meso- and meta-thoracic legs and one between the cornicles and cauda on each side. Skin reticulate. *Length*, 1.2–1.6 mm.

Nymph.—Lemon-yellow, slightly mealy. Antennae with first and second segments of the same colour as the head; third and fourth pale yellow; fifth very pale yellowish; tip dusky; sixth dusky. Eyes black; ocelli dusky. Prothorax of the same colour as the head, slightly mealy. Metathorax lemon-yellow, slightly mealy. Abdomen lemon-yellow, reticulate. Cornicles black. Cauda lemon-yellow, with dusky apex. Wing buds yellow. Legs pale yellowish; tips of tibiae and tarsi dusky.

EGYPT: Cairo, 10.vi.10 (*T. Brown*, per F. C. Willcocks).

Food-plant.—*Buddleia madagascariensis*.

Described from a few alate females and many apterae. In general appearance this species resembles *Aphis nerii* and *Aphis asclepiadis*, but it can be distinguished at once by the shorter antennae and the marked sensorial structure in the alate female; also by the shorter and thicker cornicles, the much shorter cauda, and the much longer proboscis. Although presenting a general resemblance to *A. nerii*, it is very distinct.

It occurs in great numbers on the leaves of the *Buddleia*.

8. *Aphis mathiolae* sp. nov. (fig. 8).

Alate viviparous female.—Head dusky olivaceous to blackish; eyes very dark brown, almost black. Antennae shorter than body; two basal segments olivaceous; third pale at base, dark at apex; fourth to sixth black, apex of latter slightly paler than base; first segment a little broader and very slightly longer than second; the third longer than fourth and about as long as sixth, with 13–16 round sensoria, of unequal size, over its whole length; fourth with 3–5 sensoria, a little longer than fifth; the latter may have an extra sensorium in addition to the normal subapical one; sixth about as long as 4 + 5, its basal area about one-third the length of the flagellum; segments 3–6 imbricated. Proboscis dusky at apex, reaching to or just

past the second pair of legs; its apical segment a little longer and narrower than the penultimate. Prothorax yellowish green with a dusky olivaceous collar. Thoracic lobes polished blackish or olivaceous black. Abdomen green, skin reticulate; two blackish transverse bars at the base; a submedian row of small black specks, and there may be a transverse row in front of and between the cornicles; three large black spots on the sides of the abdomen in front of the cornicles, and one at the base of the cornicles, making four on each side. Apical margin of caudal and pre-caudal segments of abdomen blackish. Cornicles dusky at base, median area somewhat greenish or pale smoky; apex dark; rather short and thick; about as long as the cauda and much shorter than the third antennal segment, imbricated. Cauda obscure ochreous; spinose, bluntly acuminate; with three pairs of lateral hairs. Anal plate darker than cauda. Legs with dusky greenish femora, paler at their base; first pair paler than second and third; tibiae yellowish, black at the apex; tarsi black; coxae and trochanters greenish. Wings with greenish insertions;

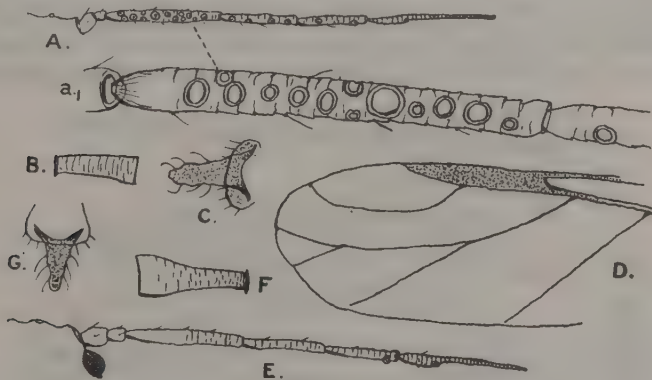


Fig. 8. *Aphis mathiolae*, sp. n.: A, antenna of alate ♀; a, third segment further enlarged; B, cornicle; C, cauda; D, apex of wing; E, head and antenna of apterous ♀, F, cornicle; G, cauda.

costa smoky; cubitus yellowish; stigma smoky; oblique veins dusky. Venter of prothorax and head greenish; of head darker than prothorax. Sternal plates blackish to blackish brown. Venter of abdomen green. A pale papilla on each side of pronotum; one between the meso- and meta-thoracic legs and one between the cornicles and cauda on each side. The cauda projects well beyond the cornicles. Length, 2 mm.

Apterous viviparous female.—Antennae shorter than body; first segment wider than second; third one and a half times as long as fourth and as long as the sixth; fourth slightly longer than fifth; sixth about as long as 4 + 5, its basal area not quite half the length of the flagellum; third to sixth imbricated. A papilla on each side of pronotum and one between the meso- and meta-thoracic legs and another between the cornicles and cauda. Proboscis reaching to the second coxae; rather broad; apical segment as wide as penultimate and a little longer. Cornicles apparently dusky, a little longer than cauda; expanding basally; imbricated. Cauda palish, projecting beyond the cornicles; spinose, with three pairs of lateral

hairs, curved at their apices. Anal plate darker than cauda; finely spinose, with some long pale hairs. Legs moderately long and thick; a few short hairs on femora and tibiae; apex of tibiae and tarsi dusky. *Length*, 1.7–2 mm.

EGYPT: Ghezireh, 15.iv.09 (*F. C. Willcocks*).

Food-plant.—Ornamental stocks.

Described from a long series collected by Mr. Willcocks (preserved in spirit) and from colour notes sent with them. It is a rather obscure species, which, however, I cannot place with any described form.

Three specimens mounted in balsam sent under the same number and food-plant differ and I place them as a separate species, which is described as *A. mathiolellae*.

9. *Aphis mathiolellae*, sp. nov. (fig. 9).

Alate viviparous female.—Differs from the previous species in that the third antennal segment has from 21–24 various-sized sensoria spread over the whole length; the fourth with 10–12 sensoria and the fifth with 3–4 sensoria. The cornicles are also of different shape (vide fig. 9) and show spiral ornamentation.

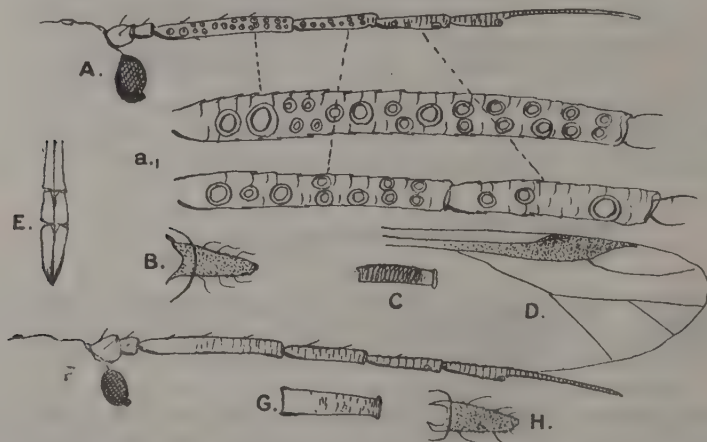


Fig. 9. *Aphis mathiolellae*, sp. n.: A, head and antenna of alate ♀; a, antennal segments further enlarged; B, cauda; C, cornicle; D, apex of wing; E, apex of proboscis; F, head and antenna of apterous ♀; G, cornicle; H, cauda.

Apterous viviparous female.—This differs in the more cylindrical form of the cornicles, etc., from the previous species.

EGYPT: Ghezireh, 15.4.09 (*F. C. Willcocks*).

Food-plant.—Ornamental Stocks.

Found with *Aphis mathiolae*. It may be a variety of it, but the marked structural differences of antennae and cornicles seem to me to indicate clearly that it is a separate species.

Described from several alate females and a few apterae.

10. *Aphis pruniella*, sp. nov. (fig. 10).

Alate viviparous female.—Antennae shorter than body; basal segment wider and longer than second; third longer than fourth, but not quite so long as the sixth, with 4-5 round sensoria scattered over the whole length; fourth and fifth about equal in length, the latter with a normal subapical sensorium; sixth with basal area about half the length of the flagellum; all the segments imbricated. Head flat in front; eyes large; stemmata marked. Proboscis reaching to third coxae, acuminate; apical segment longer than the penultimate; pale at base, dark at apex. A prominent papilla on each side of pronotum and one between the meso- and meta-thoracic legs; there are also other smaller lateral abdominal papillae. Cornicles dark, moderately long, cylindrical or slightly swollen towards the base; markedly imbricated, the imbrications long; sides serrated. Cauda not nearly as long as the cornicles; dark; spinose, with three pairs of long lateral hairs, the apical pair curved inwards. Anal plate dark; spinose, with some long hairs. Legs with apices of tibiae and all the tarsi dark; tibiae with a few short hairs. Wings much longer than the body; the costa, stigma and veins yellowish brown; membrane slightly tinged. Length, 1.5 to 1.9 mm.



Fig. 10. *Aphis pruniella*, sp. n., alate ♀: A, head and antenna; B, cornicle; C, cauda.

Apterous viviparous female.—Antennae shorter than body; basal segment larger than second; third a little longer than fourth, not quite so long as the sixth; fourth and fifth equal in length, the latter with the normal sub-apical sensorium; sixth with basal area half as long as the flagellum; all the segments from the third imbricated; the third and fourth paler than the remainder. Head with small lateral prominences; eyes large. Proboscis reaching past second coxae, acuminate; apical segment longer than penultimate. Prominent lateral pronotal papillae; a large papilla between meso- and meta-thoracic legs. Skin markedly reticulate. Cornicles fairly large; black; somewhat expanding towards the base; markedly imbricated; sides serrated. Cauda dark; very spinose; not so long as the cornicles; with three pairs of lateral hairs, curved apically. Anal plate dark, spinose, with a few long hairs. Legs with apices of tibiae and all the tarsi dark. Length, 1.5-1.9 mm.

BRITISH EAST AFRICA: Nairobi (T. J. Anderson).

Food-plant.—Plum.

Described from a number of alatae and apterae preserved in spirit. It appears to be a darkish species, with paler (apparently deep greenish) abdomen, and with dark antennae, cornicles, cauda and anal plate, and black thorax in the alatae. The sensoria on the antennae in the alate female separate it from any species I have yet seen on *Prunus*. The common *Aphis pruni*, Linn., has many sensoria on segment three and a good many on four and the cornicles are green, not black.

11. *Aphis pomonella*, Theobald (fig. 11).

Canad. Ent., xlviii, p. 262, fig. 9, 1916.

BRITISH EAST AFRICA: Nairobi (*T. J. Anderson*).

Food-plant.—Apple.

Closely related to *Aphis pomi*, but can at once be separated by (1) the different antennae and (2) by the shorter cornicles. *A. pomi* has more sensoria on segment



Fig 11. *Aphis pomonella*, Theobald. alate ♀: A, head and antenna; B, cornicle; C, cauda.

three and more irregularly disposed, and also some on segment four. Some American Aphidologists have pointed out to me that this may be only a variety of *Aphis pomi*, De Geer.

12. *Aphis pheidole*, Theobald.

Ent. Record, xxviii, p. 37, 1916.

Found associated with ants (*Pheidole* sp.) at Mwengera, N.-W. Rhodesia, ix. 1913.

13. *Aphis acetosae*, Koch (non Linn, Fabr, Buckton) (fig. 12).

Koch, Die Pflanz., p. 145, figs. 197, 198 (1857).

EGYPT: Ghezireh, 3.iii.09 and i.iv.09 (*F. C. Willcocks*). ENGLAND: Wye, Kent, 7.vi.15 (*Theobald*). GERMANY (*Koch*).

Food-plants.—*Rumex* spp.* and *Papaver* spp.†

Linnaeus' and Fabricius' *Aphis acetosae* in the alate female has two dark bars across the abdomen and also the *Aphis acetosae* of Buckton.‡ The specimens from Egypt and those I found at Wye show no trace of this ornamentation. These agree closely with the *Aphis acetosae* of Koch. I append a detailed description of this species, which must receive a new name, and I propose *acetosella*.

Alate viviparous female (Rumex form).—Head shiny black to very deep shiny olivaceous; eyes dark. Antennae black; first segment wider than, but of the same length as, the second; third longer than fourth but not quite so long as sixth, with 13–18 sensoria over its whole length; fourth longer than fifth, with 2–5 sensoria, three usually placed basally; sixth as long as 4 + 5, its basal area about half as long as the flagellum; the usual sensoria on fifth and sixth; all segments from third imbricated. Proboscis reaching to second coxae; green, with black apex. Pronotum green in front and behind, black between. Thorax shiny black. Abdomen green, very shiny; some with a dark green median line, others with the whole dorsum mottled with deeper green; on the sides of the abdomen are three dark

* Syst. Nat., ii, 7346.

† Ent. Syst., iv, p. 220 (1794).

‡ Monog. Brit. Aphid., ii, p. 80, pl. lxii, pp. 5–7 (1877).

spots, cephalad of the cornicles. Venter of head and thorax dark green; sternal plates black; venter of abdomen black. Cuticle of abdomen markedly reticulate. Cauda dark green to dusky black; in some with a greenish apex; not so long as the cornicles; spinose, with four (? three) pairs of lateral hairs, the apical pair curved. Anal plate dark and spinose, with some long apical hairs. Cornicles black; in some deep olivaceous, with a dusky marking on inner side of base (not equally visible in all specimens); slightly expanding basally and strongly imbricated; imbrications long. Cauda projecting well beyond cornicles. A pale pronotal papilla on each side, one between the meso- and meta-thoracic legs, one caudad of the cornicles, and traces of five lateral abdominal ones. Legs with the first femora dull ochreous-brown; tibiae ochreous with dark apex; tarsi black; second femora dusky, except at base; tibiae ochreous, with black apex; tarsi black; third pair of legs same as second; in some specimens the legs have a greenish tinge. Wing insertions greenish; costa smoky; cubitus green; stigma smoky; lower margin greenish; veins dusky. *Length*, 2-2.5 mm.

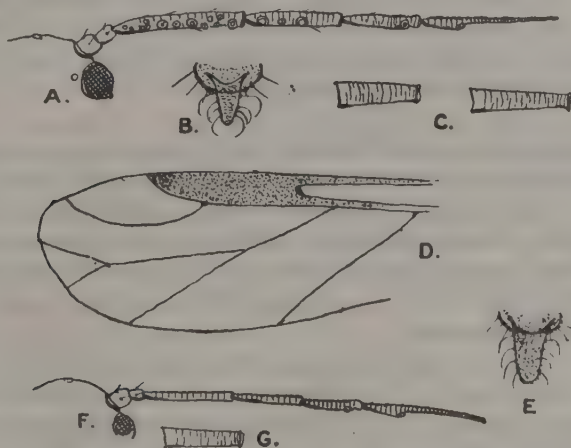


Fig. 12. *Aphis acetosella*, nom. n.: A-D, alate ♀; E-G, apterous ♀.

Alate viviparous female (Papaver form).—Very similar to the preceding form, but the antennae are as follows: first three segments like those of the *Rumex* form, fourth longer than third, with 1-4 sensoria, three being placed more towards the apex; basal area of sixth one-fifth the length of the flagellum.

Apterous viviparous female (Rumex form).—Head greenish to reddish yellow. Eyes deep reddish-brown to black. Antennae not half the length of body; basal segment greenish; second greenish, but darkened apically; third black, except at base; fourth, fifth and sixth black; basal segment larger than second; third longer than fourth, nearly as long as the sixth; fourth and fifth nearly equal. Thorax and abdomen a rich green with darker suffusions, to a rich yellowish-green. Cornicles greenish, with dusky apices; cylindrical, slightly expanding basally, faintly imbricated. Cauda yellowish green, not quite so long as the cornicles, blunt; with four pairs of lateral hairs; spinose; projecting well beyond the cornicles. Anal

plate dusky; spinose, with a few apical hairs. Lateral papillae as in alate female. Legs ochreous; apical parts of femora brownish ochreous; tips of tibiae brownish; tarsi black. *Length*, 1.5–2 mm.

Nymph.—Head yellowish green; eyes dark blackish-brown. First two segments of antennae greenish; third pale at base; remainder dusky; sixth darkest. Pronotum green, yellowish green at sides. Thorax with median area yellowish green; future thoracic lobes outlined with deeper green. Base of wing-buds pale whitish-green; tips dark sepia. Abdomen rich green; apex paler. Cornicles green, with dusky or black apex. Legs pale ochreous or greenish; apex of tibiae and the tarsi dark. The nymph shows some mealiness on the head and abdomen subdorsally and laterally in the form of mealy whitish areas, more marked in some specimens than in others.

Apterous viviparous female (Papaver form).—Somewhat greenish yellow to yellow or pale yellowish-green. Head yellowish; eyes very dark brown. Antennae with first and second segments of the same colour as the head; third to fifth pale; fifth slightly smoky at apex; sixth smoky. Thorax and abdomen yellowish green. Cornicles pale, with dark apex. Skin of thorax and abdomen very finely wrinkled. Some specimens show a faint median dorsal and submedian lines of a green hue. Legs pale, apices of tibiae pale brownish, tarsi black.

Nymph.—Head pale yellowish-green; eyes black. Antennae with first and second segments pale, also third and fourth; fifth pale smoky, rather darker towards the apex; sixth smoky. Prothorax green, median area pale. Thorax green or pale green; thoracic lobes more or less defined by deeper green borders. Base of wing-buds white to green; wing-buds dusky. Abdomen green; a median dorsal line of a darker green and submedian lines of the same colour. Cornicles pale, with dark apical ring. Femora pale, with faint greenish reflections; tibiae pale; tarsi black. Apex of abdomen pale greenish.

I cannot see any very marked structural differences between the specimens taken on *Rumex* and those found by Mr. Willcocks on Shirley poppies in Egypt, except that on the latter plants the basal area of the sixth antennal segment is relatively shorter than in the *Rumex* form. The colours are the same and the sensorial structure of the antennae, the structure of the cornicles and the cauda agree exactly within general limits. It is likely that there is a migration between *Rumex* and *Papaver* and probably other plants, as we see with *Aphis rumicis*. Thus I have placed the Green Poppy Aphid with the Green Rumex Aphid provisionally. Mr. Willcocks thinks the same species occurs on thistles (*Carduus*) and lettuce (*Lactuca*). I can detect no difference between the Green Rumex Aphid of Europe (*Aphis acetosae*, Koch) and those sent from Egypt.

Linnaeus', Fabricius' and Buckton's *Aphis acetosae*, I think, are only pale varieties of *rumicis*—the dark transverse abdominal bands described being clearly seen in the latter on certain plants and being more marked in certain years than in others when on *Rumex*. Walker* placed Linnaeus' *acetosae* as a synonym of *rumicis*. In 1912 I considered it distinct on account of taking Koch's *acetosae* for Linnaeus' species.†

* List. Homopt. Ins. Brit. Mus., pl. iv, p. 982 (1852).

† Journ. Board Agric., p. 467 (1912).

Fabricius* says of *Aphis acetosae*, Linn., "Parvus totus niger fascia viridi. Habitat in Rumice acetosa."

Buckton† says of his alate female, "Head and thorax shiny black. Abdomen shining, dark olive-green, with obscure transverse bars"; and of the apterous female, "dark brown or nearly black"; he figures the alate female as all black (Plate lxii, fig. 7).

Miss Patch‡ lists Linnaeus' *acetosae* on *Atriplex hortensis* (Hunter, 1901, p. 104), and Kalténbach§ records Fabricius' *acetosae* on *Rumex conglomeratus*; presumably these refer to Linnaeus' species and not the *acetosae* of Koch.

The colour notes were sent me by Mr. Willcocks.

14. *Siphocoryne (Aphis) pseudobrassicae*, Davis.

Canad. Ent., xlii, pp. 231-234 (1914).

Professor Davis of Lafayette, Indiana, writes me that he has received this species from Mr. Lounsbury from the Cape.

It is closely related to *Aphis brassicae* and can, so far as I can see, be separated from that species only by the alate female having sensoria on segment four of the antennae.

It is found on radish, turnip, rape, kale, mustard and turnip greens. Davis records it from Geneva, New York; Evansville, Indiana; Lafayette, Indiana; and College Station, Texas.

The specimens I recorded from turnips from Onderstepoort, Transvaal, as *Aphis brassicae* (Bull. Ent. Res., iv, p. 320, 1914) show no trace of sensoria on segment four, so are undoubtedly not this species. The other African records I have given refer only to apterae and these evidently cannot be separated in the two species.

15. *Hyalopterus insignis*, sp. nov. (figs. 13, 14).

Apterous viviparous female.—Rich dull brown, covered with white or slightly greyish-white farinose or flocculent secretion, except in certain areas (figure 13) which appear black to the naked eye or low power lens; this ornamentation is very marked in fresh specimens. Head entirely covered with white secretion; eyes black. Antennae slightly less than half the length of the body; the first and second segments dusky; the third ochreous, dusky towards the apex; rest of antennae all dusky; first segment considerably larger than second; third as long as fourth and fifth, and about as long as the sixth; fourth and fifth about equal; third to sixth showing faint imbrication; basal area of sixth not nearly as long as the flagellum. Proboscis short and thick, only just reaching the base of second pair of legs; the last two segments nearly equal in length; the apical one bluntly acuminate. On pro-, meso- and meta-notum a dark central area, remainder (except for narrow

* Ent. Syst., iv, p. 220 (1794).

† Monog. Brit. Aphid., ii, p. 81, pl. lxii, figs. 5-7 (1877).

‡ Bull. 220, Maine Agric. Exp. Sta., pp. 289-290 (1913).

§ Die Pflanz. Ins., p. 519 (1874).

markings as figured) covered with white farinose matter. Abdomen showing one large median black area, a dark line between the cornicles and a dark median line. Fore femora and tibiae ochreous; tarsi black; mid and hind femora black; tibiae ochreous, with black apices; tarsi black; a few short hairs on femora and tibiae; coxae dark. Cornicles short; conical to cylindrical; black; from one-third to nearly half the length of the cauda. Cauda black, bluntly acuminate, spinose. Anal plate black. *Length*, 1·5–1·8 mm.

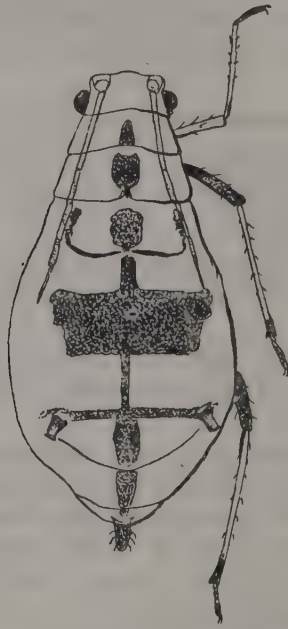


Fig. 13. *Hyalopterus insignis*, sp. n., apterous ♀, showing dark areas; greatly enlarged (F. C. W.).

These specimens were found in January. Colonies found in June had the brown colouring not so dark, but some so dark as to appear black to the naked eye. The cauda was also noticed to be of the same colour as the body, not black. The extent and shape of the naked areas (*i.e.*, devoid of mealy secretions) are slightly variable, but all exhibit the large area in the median region of the abdomen, and in some the dark brown between the cornicles surrounds their base.

Alate viviparous female.—Dusky rich brown, covered with a greyish white farinose secretion. Eyes red. Antennae with first segment dark; second pale; third pale at base, its apex and other segments dusky. Femora all dark; tibiae yellowish, apex of second and third pairs dark; tarsi dark. Cornicles and cauda dark. Wing insertions yellowish; costa, cubitus, stigma and other veins dark.

The above is the general appearance of the January brood.

The June brood is described by Mr. Willcocks as follows :—

Head black and shiny, but sparsely covered with farinose secretion and so appearing a dusky grey; eyes red. Antennae with first segment dusky; second to fourth yellowish; fifth yellowish with smoky apex; sixth dusky. Thorax of the same colour as the head. Abdomen brown, a mealy band at base, lateral margins mealy; a lateral row of four mealy, overlying dusky, slightly protuberant spots; two conspicuous mealy areas surrounding the cornicles; apex mealy; middle part of abdomen always naked and thus dark. Cornicles dark. Cauda brown. Legs: first pair yellowish; tarsi dark; second pair with dusky femora, yellow tibiae and dark tarsi; third pair as in the second, but the apex of the tibiae dark. Wing insertions yellowish; stigma smoky; cubital smoky; costa and obliques dusky. The antennae are shorter than the body; basal segment larger than second; third as long as 4 + 5 and slightly longer than sixth, with 5-6 large round sensoria; fourth very slightly longer than fifth, to about equal; basal area of sixth more than half as long as the flagellum.

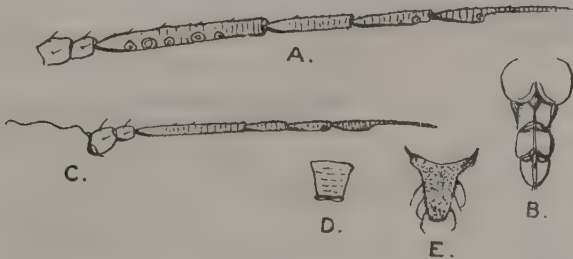


Fig. 14. *Hyalopterus insignis*, sp. n.: A, antenna of alate ♀; B, proboscis; C, head and antenna of apterous ♀; D, cornicle; E, cauda.

Nymph.—Head and thorax dusky, mealy; eyes dark red. Antennae with the two basal segments of the same colour as the head; third to fifth pale yellowish, almost yellowish white; sixth smoky. Thorax brownish, but its sparse farinose covering gives the appearance of an ill-defined grey, tinged with green. Apical half of wing-buds darkest. Abdomen brownish and mealy, but the median area and median line are bare of the mealy substance. Cornicles dark. Cauda of the same colour as the body. Legs very pale yellowish or yellowish white, slightly farinose; femora of third pair smoky.

EGYPT: Ghezireh, 20.i.1912 (*F. C. Willcocks*).

Food-plant.—Reed grass or buffalo grass.

Described from spirit specimens and slides sent me by the collector with his colour notes on the various stages.

It lives in colonies on the undersides of the leaves.

It is a very marked species, easily recognised when alive by the marked decoration of the body.

16. *Myzus pterisoides*, sp. nov. (fig. 15).

Alate viviparous female.—Dark in colour, with deep reddish abdomen, as seen in spirit specimens; some seem to be all black; some appear as if greenish and paler beneath. Mounted in balsam, the head and thorax are black; the abdomen garnet red. Antennae dark; longer than the body, the sixth segment paler than the rest; basal segment wider and longer than the second; third longer than fourth to almost the same length, with 7–9 round sensoria on the basal half; the third from the base being usually smaller than the rest; fourth a little longer than fifth; sixth as long as $4 + 5$. Eyes very large, dark; median ocellus prominent. Proboscis reaching to third coxae, in a few even just beyond and in others scarcely to them; the last two segments nearly equal. Legs rather long and thin, dark; tibiae paler, except at apex. Cornicles black, long, thin, cylindrical, slightly swollen in the middle or nearer the apex; faintly imbricated; with a few transverse striae apically, almost of reticulate nature, shorter and thicker than third antennal segment to nearly the same length. Cauda small; pale to pale dusky; bluntly acuminate, spinose, with three hairs on each side, curved apically; the small cauda is very

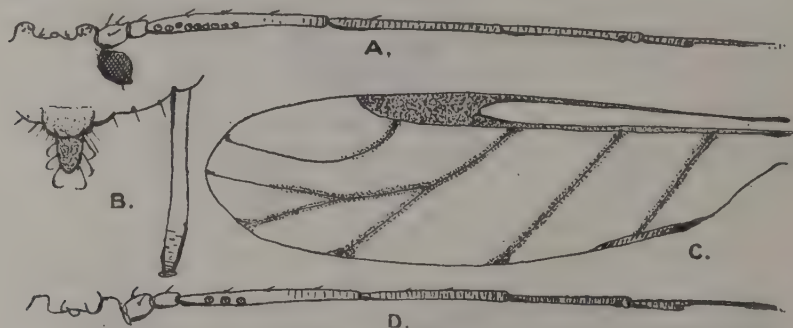


Fig. 15. *Myzus pterisoides*, sp. n.: A, head and antenna of alate ♀; B, cauda and cornicle; C, wing; D, head and antenna of apterous ♀.

markedly shorter than the long cornicles; in some specimens they appear as if dull smoky yellow. Hairs of head and body short and rather blunt. Wings normal; with dark veins, the membrane being tinged very narrowly on each side of the veins and slightly more markedly so where they join the border; stigma smoky. Length, 1.6–2 mm.

Apterous viviparous female.—Dark; some paler beneath. Antennae longer than body; basal segment slightly longer and much broader than the second; third longer than the fourth, but shorter than the sixth, with 3–4 round sensoria near the base; fourth longer than the fifth; sixth as long as $4 + 5$. Eyes large and apparently dark. Proboscis reaching to third coxae; in a few beyond and in some just cephalad. Cornicles black; cylindrical, but irregularly swollen to a slight extent; about as long as the fourth antennal segment; faintly imbricated and slightly expanded basally. Cauda paler; small, spinose, with three hairs on each side, pale and curved and more or less closely appressed to the cauda. Legs long and thin; dark, except

base of femora ; with a few scattered hairs. Anal plate dark, with some long, pale hairs. Small, slightly capitate hairs on the head ; body apparently with no hairs. Length, 1.8–2 mm.

UGANDA : Kampala (C. C. Gowdey).

Food-plant.—Ferns.

Described from a number of alatae and apterae. Its general appearance and shape resemble at first sight *Idiopterus nephrolepidis*, Davis, found on ferns in America and England, but it is quite distinct. The wings show a marked, yet narrow pale clouding along most of the veins, which also make it resemble Davis' species, but the typical *Myzus* character and the antennal structure are quite distinct. The colour can only roughly be described, as no colour notes were sent.

In alcohol this insect gives a rich deep port-wine stain to the fluid.

New Localities and Food-plants.

Rhopalosiphum dianthi, Schrank.

Bull. Ent. Res., iv, p. 320 (1914) ; vi, p. 153 (1915).

EGYPT : Cairo, 21.iii.08 and Spring, 1907 ; Ghezireh, 21.ii.08 (F. C. Willcocks).

Food-plants.—On cabbages and savoys in great numbers, both alatae and apterae, in company with *Aphis brassicae*, Linn.

Aphis (Siphocoryne) brassicae, Linnaeus.

Bull. Ent. Res., iv, p. 320 (1914).

EGYPT : Cairo, 16.iii.08 and Spring, 1907 ; Ghezireh, 21.ii.08 and 2.iv.09 (F. C. Willcocks).

Food-plants.—On cabbage and savoys, in company with *R. dianthi* ; many alate females and apterae. This species is now placed in the genus *Siphocoryne*, and I think correctly.

Hyalopterus pruni, Fabricius.

Hyalopterus arundinis, Fabricius.

Hyalopterus phragmiticola, Oestlund.

Previously recorded from Cairo on *Prunus* spp. and various rushes (*Arundo*).

Recently Mr. Willcocks has sent me specimens from the apricot or mishmish, taken at Gizeh (10.iii.10), both alate and apterous females and also oviparous females taken in January and notes on a winged male from the same locality. His descriptions of the sexual forms are appended. He also sent specimens taken on reed grass taken in February in the same locality. He finds that this grass is the only alternative food-plant to the peach, apricot and plum. The insect appears in large colonies on the underside of the leaves of the apricot, the leaves being little malformed or curled, most hardly at all, a few with the margin slightly turned down. The attack is usually severe during the spring months and the growth of young trees is checked. The effect of this Aphid on peach is more marked, the foliage suffering to a greater degree.

I have never seen it on apricot or peach in this country, but it has been sent me from the former from Woodbridge, Suffolk.

Oviparous female.—Apple-green, of a darker shade than the viviparous female or spring stem-mother, with an irregular dorsal line of a darker shade of green than the general colouring. Head green, in some lights dusky green, very sparsely and irregularly covered with whitish meal; eyes very dark red. Antennae with the two basal segments green; the second paler than the first; third and fourth paler green; fifth smoky, base pale. Prothorax and mesothorax green; pronotum sparsely covered with meal. The median dorsal green line commences on the anterior margin of pronotum and continues back as far as the base of the cornicles. Abdomen green, apical part from about base of cornicles to cauda of a darker shade of green or bluish green. Cauda green, hairs pale. Cornicle short and dark. Legs: first and second pairs all green, except the dark tarsi; in third pair the tibia is obscure greenish-ochreous; tarsi dark. Venter and coxae green."

The most conspicuous features of the oviparous female are the small size and the prominent lateral accumulations of white matter, with which the shell of the ova is covered. This secreted substance is pure white and fibrous, the fibres short and rather coarse.

The ova are 0.66×0.34 mm.; black, and covered with a white woolly coat; when first laid yellowish green in colour. They are laid in the axils of the buds.

Mr. Willcocks describes the oviposition as follows:—"The female takes up a position in the axil of a bud; after the egg is laid she by means of her third pair of legs scrapes off the white secretory matter from the two masses on the abdomen and packs it on the shell of the egg, to which it adheres. I watched a female carrying out this process for 35 minutes, at the end of which period she left the egg, the latter having been fairly well covered. During the covering the abdomen is moved about slightly and may help in the work."

The oviparous females were found in January.

A NEW SCOLYTID INJURIOUS TO DRIED SWEET POTATOES IN JAMAICA.

By Lt.-Col. WINN SAMPSON, F.E.S.

The specimens here dealt with were collected by Mr. A. H. Ritchie, Government Entomologist for Jamaica, and were handed to me for determination by Dr. Guy A. K. Marshall, Director of the Imperial Bureau of Entomology.

At present this beetle appears to be known only as causing serious damage to dried sweet potato chips.

***Hypothenemus ritchiei*, sp. nov.**

♀. Head subglobose, black, punctate and rugose, the front having greyish hairs from the mouth to the middle of the eyes, the remainder of the surface being bare, with a longitudinal central elevation above the mouth. The antennal funiculus four-jointed, the first being globular and the other three transverse, increasing very slightly in breadth; the club bluntly ovate and subsolid, with faint traces of sutures indicated by punctures and longish hairs, and having a dark mark resembling folded tissue extending from one edge to the centre in an oblique direction. The eyes are elongate and slightly rounded in front. The prothorax is a little longer than broad, with the sides narrowed anteriorly and rounded apically; the anterior half is tuberculate the remainder being rugose, the entire surface furnished with minute hairs and scales; it is obliquely impressed on each side of the disc and has a sharply defined posterior ridge or margin at the base.

The elytra are half as long again as the prothorax, but of equal breadth, with parallel sides and obtusely rounded apically; they are irregularly punctured and rugose from the base to the declivity and from there to the apex are furnished with punctured striae and a few irregularly placed scales, the interstices having a single row of tubercles with a large scale attached to each. The scutellum is triangular. The anterior coxae are large, elongate and contiguous, the tibiae being flattened, rounded exteriorly and toothed; the third tarsal joint is broader than the others but not bilobed. The legs are very much paler in colour than the rest of the body. The abdominal segments are clothed with parallel rows of fine hairs. Length, 1.5 mm.

JAMAICA.

The mature beetles are of a uniform dark brown colour, including the antennae, the legs being pale yellow. The oblique marking on the antennal club is described by Hagedorn as "Sensitivstreifen" and is found in *Diamerus*, Erich., *Strombophorus*, Haged., and other genera.

SOME PRACTICAL METHODS ADOPTED FOR THE CONTROL OF FLIES IN THE EGYPTIAN CAMPAIGN.

By Capt. J. DAVIDSON, D.Sc., F.E.S., R.A.M.C. (T.).

The control of flies is a serious problem in the Egyptian Campaign. In desert camps flies develop at an extraordinary rate, unless rigid sanitary precautions are taken. In native villages they seem to be taken as a matter of course, and it is a common sight to see fruit and food of all kinds, in shops and on street-vendors' carts, swarming with flies. Small children suffering from conjunctivitis are seen in the streets with their eyes thickly covered with flies. Flies of the house-fly type (*Musca*) are the most troublesome, although blue-bottles (*Calliphora*), green-bottles (*Lucilia*) and *Sarcophaga* are found. These latter are often met with in the desert in the small clumps of palm trees known as "hods."

Owing to the conditions of active service the writer was unable to obtain detailed accurate data of the various species met with, or as to their life-history. During the advance of the troops across the Sinai desert, one's time was fully taken up with practical methods on a large scale for keeping down flies.

Flies are present in Egypt practically all the year round, although during the height of the hot weather, and again about December, they are not so numerous.

Whenever the troops halted in the desert and formed a temporary camp a high standard of sanitation was insisted on, however short the stay. In this way breeding places were kept under control and fly-breeding was reduced to a minimum. When troops march out from a camp area crowds of flies are always carried with them. They may sometimes be seen in hundreds on the shady areas on men's backs and on horses. When the troops arrive at a new camp area these flies soon lay eggs, and unless strict sanitary precautions are taken, a fly-plague results.

One has only to experience the worry and inconvenience caused to tired and sick men by flies under the trying heat of the African desert, and to understand that diarrhoea, dysentery, typhoid and cholera may be spread by them, to realise how important it is to suppress them rigorously.

Sanitation in Egypt has reached a very high degree of efficiency, especially in the base camps. In the desert, the mobile conditions of active service present more difficulties, but notwithstanding this, a really efficient system of sanitation is carried out, the beneficial results of which are undoubtedly proved by the low sickness rate obtaining amongst the troops.

An account of the author's experiences when commanding a Sanitary Section in the Egyptian Expeditionary Force during the year 1916-17 may be helpful to others interested in the fly problem. The personnel of the section included 25 N.C.O.'s and men specially trained in sanitation.

The aim was to inhibit fly-breeding and to prevent the spread of disease. Special treatment of breeding places and the destruction of flies by spraying, poisoned bait, traps, etc., were carried out. The three favourite breeding places for flies of the house-fly type are (1) horse-manure, (2) accumulations of camp and cook-house refuse, (3) latrine trenches; while those of the blue-bottle type favour putrefying animal matter.

By careful disposal of horse manure, by efficient incineration of refuse, and by systematic treatment of latrine trenches, especially when being filled in after use, the basis of the fly-problem was attacked.

I. Disposal of Horse-manure.

As straw or bedding of any kind was not used in the desert, there was only the horse droppings and urine to consider. The manure, however, became so much mixed with sand that disposal was often a very difficult matter. A G.S. wagon-load of manure would often contain 50 or 60 per cent. of sand. Many methods were tried for dealing successfully with the manure under the varying conditions of a desert campaign, and those which gave the best results were:—(1) Close-packing and spraying; (2) incineration; (3) making manure roads.

(1). *Close packing and spraying.*—This method is specially suited to a large camp and gave good results in a big camp near Suez.

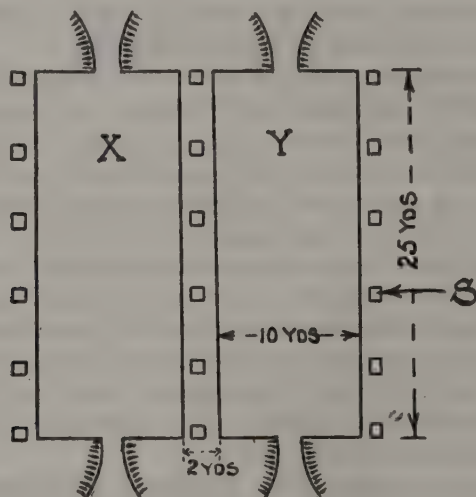


Fig. 1. Treatment of horse-manure by spraying:
X, Y, manure dumps; S, tins for sodium arsenite.
W, water tank.

A site was selected about 2,000 yards away from the camp and staked out as shown in fig. 1. Two areas, X and Y, each 25 yds. long by 10 yds. wide with an interval of 2 yds. between them, were marked out with four corner-posts. To these, all manure from the horse-lines and all burnt refuse from the incinerators were hauled. On the first day everything was dumped on the area X. On the second day on the area Y, and so on alternately. On an average there were 80 G.S. wagon-loads daily, and a gang of 20 Egyptian labourers under the supervision of an N.C.O. were employed at the dumps. As the wagons were unloaded on the dump, these men raked it level and square, picked out tins, etc., which were stacked near by, while old sacking, paper, tibbin, etc., were burnt.

Near by a 300-gallon tank was erected, and this was filled with water daily. A rough working emulsion, made with crude tar oil (bought very cheaply locally) and soft soap, was mixed in the tank. Green oil was used when available. In the late afternoon, the surface of the heap which had been used that day was thoroughly drenched with this crude emulsion, at the rate of 1 gal. per square yard, with watering cans. It was then covered with large pieces of sacking which had been sewn together. This covering was left on during the following day, when the adjoining heap was used, and then treated in the same way and so on, on alternate days.

When the writer arrived at this large camp, there was a tremendous number of flies, and during the first few days they came in hordes to these dumps from breeding places not yet dealt with, being carried from the camp on the loads of manure, the men's backs and on the horses. A number of oil-drums were placed round the heaps as shown in fig. 1. These were turned upside down and the bottoms made concave like saucers. Early every morning a solution of 1 per cent. sodium arsenite in water containing 12 per cent. glycerine and 5 per cent. sugar was poured on these drums. The flies collected in masses and were killed in enormous numbers, and at the end of a few days hardly any remained, the treatment of the manure preventing further breeding in it.

The addition of 80 G.S. wagon-loads of manure and burnt refuse daily soon increased the size of the heaps. The labourers raked the heaps flat and square and wagons used to pull up on the top of the heap at one end and when unloaded went off at the other end. This helped to pack the heaps very tightly. These two dumps lasted for four weeks, being at that time about 5 feet high. New dumps were then started. The sacking cover over the heap was found unnecessary, and as a matter of fact, owing to the great heat of the sun and fermentation heat, or an accident, one cover took fire.

The removal of all burnt refuse from the camp to the dump did away with other breeding places in the camp, and there was a very appreciable decrease in the numbers of flies after a few days.

(2). *Incineration of horse-manure.*—It was not possible to carry out the method described above with mobile units out on the desert, owing to the scattered camps and the difficulty of transport. Under these conditions, incineration of the horse-manure was tried. Each unit was made responsible for burning its own manure. Incinerators were made of sheets of corrugated iron of the open brazier type, or of biscuit tins filled with sand, with tibbin-bale wire as fire-bars. Owing to the large amount of sand mixed with the manure, it was necessary to sift it before putting it into the incinerator. Wire mesh screens were provided for units, and the siftings, which contained a quantity of pulverised manure, were put into a deep pit and liberally treated daily with crude tar oil. This is an important point, for if siftings are neglected, they afford a very satisfactory breeding ground for flies. The writer has found untreated siftings literally seething with fly maggots. Another important point is to ensure that each day's manure is thoroughly disposed of and not left on the ground. If possible, it is well to have a hard platform made of galvanized iron on which to put the manure. Otherwise, a little of the manure may be left on the

sand ; it gets mixed with it and practically a carpet of manure and sand is left round the incinerator, and in this flies breed in enormous numbers. The ova hatch out and the maggots soon burrow down into the sand and pupate. At a camp of Indian troops that the writer visited, where horse-manure was being incinerated, there were several neat mud-wall drying platforms near the incinerators, in which the manure was put. On examining these, the bottom few inches of manure was found to be three or four days old and was seething with fly maggots.

(3). *Spreading manure by making manure roads.*—This method, when very carefully supervised, is satisfactory, especially during the hot weather. During the winter months however it is not so satisfactory and incineration was insisted on.

When the manure is spread along a road track, supervision is easy. These manure roads are much better for horses to walk on than the loose desert sand. Roads about 15 feet wide, leading from the camp out into the desert, were staked out. The day's manure from the camp was spread along a certain length of this road and raked out by Egyptian labourers, so that in no place was the manure more than one inch thick. All droppings were broken up. The next day a further piece of the road was covered in the same way. On the third, fourth and fifth days a further piece was covered. Under the extreme heat of the desert sun the manure quickly dries, and moisture is necessary for fly-breeding. After the fifth day another layer one inch thick was added on the first day's layer, and so on. Four days were thus allowed to elapse before another layer of manure was added to the previous layer. In this way a good road of dry pulverised manure was formed. This method needs constant supervision in order to ensure that the manure is spread thinly, otherwise patches or "pockets" of manure here and there may breed flies.

The practice of burying manure direct from the horse-lines in the desert is a great danger. The writer has found larvae, pupae, and newly hatched flies in the sand where manure had been buried. The eggs are laid on the manure in the horse-lines, and when it is buried, the warmth of the sand and moisture from the manure, make conditions favourable for fly-breeding. Horse-lines were thoroughly raked over twice a day so as to expose the sand to the sun.

II. Treatment of Latrines.

In large standing camps incineration of faeces is frequently carried out, but in general a deep trench system of latrines is established. The latrine trenches are about 8 feet deep and covered with "fly-proof," box-pattern latrine seats having self-closing lids. These are made in large numbers and are available at R.E. Parks. Owing to the loose nature of the sand in most districts all latrine trenches have to be revetted with sandbags or wooden revetments. On account of the warping of the wood-work, damage to lids, etc., the latrine seats are not absolutely fly-proof. Latrine trenches were sprayed daily with "C" fluid, 5 per cent. cresol, or kerosene, the latter being the most effective in keeping flies away.

When the contents of the trench reached to about 18 inches from the top, the trench was carefully filled in in the following way :—The contents and sides of the trench were thoroughly sprayed with "C" fluid, cresol 10 per cent., or crude tar oil. The trench was then filled in with sand thoroughly mixed with crude tar oil, the top layer of sandbag revetment being removed. A mound made with tibbin and sand

in the proportion tiffin 6, sand 1, with water, was formed over it. This set quite hard and practically imprisoned all flies which might be breeding out in the trench. In some districts mud or clay was available for this purpose. Fly maggots which hatch out in the trench crawl in between the sandbags forming the revetment and pupate there. The flies which hatch out may burrow their way out diagonally from the trench through the loose sand. To avoid this the mound was extended for an extra 18 inches all round the trench.

Major E. E. Austen recommended the following method of dealing with this, which is very effective. A piece of canvas soaked in crude tar oil is stretched over the trench about six inches below the surface, extending to 18 inches all round it. A second trench about six inches deep is made round the trench and a foot from the edge of it. This is filled with sand mixed liberally with cresol and tightly packed. The whole is then covered over with a mound. In this way any flies which emerge laterally are trapped.

The danger of open shallow trenches cannot be too greatly emphasised. On inspecting, some days later, areas in the desert which had been temporarily occupied by bivouacing troops, newly hatched flies were found running about the sand in hundreds. By digging in the sand at certain places where shallow trench latrines and pits for unburnt refuse had been, shoals of pupae were found. It is absolutely essential so to localise sanitary areas for latrines and refuse, that they may be readily and efficiently treated.

The author has found large numbers of flies breeding out from latrine trenches which, although they had been covered with a box latrine, had been afterwards carelessly filled in. The flies hatch out and make their way through several feet of the loose desert sand. An open trench 5 feet deep was used for three days and then filled in with 4 feet of the desert sand without any further treatment. Flies were found emerging from this trench 10 days afterwards, and numbers of pupae were found 18 inches down, in the sand with which the trench had been filled. On examination, two weeks later, of latrine trenches filled in as described above, pupae have been found in the top layer formed of crude tar oil and sand, but they were small, malformed, and had failed to develop.

Native latrines.—A large number of native labourers are employed with the troops, and the deep-trench system of latrines is in force for them. These are covered with flat squat, fly-proof covers having self-closing lids. By strict policing and supervision this system works satisfactorily. One native is always on duty at the latrines as policeman. The danger from indiscriminate defaecation by individuals in the open is very great, and strict orders to prevent this are necessary, especially with large bodies of native labourers.

Several casual deposits defaecated on the soft desert sand by native labourers were kept under observation. Flies collected on the faeces almost immediately. The surface of the deposits soon dried in the hot sun, forming a hard coating, but there was enough moisture below this for the fly ova to hatch out. On the third day, numbers of maggots were present in the faeces, which were thoroughly disintegrated by them in two or three days, the whole being turned into a dry, powdery heap. The larvae, which were small and ill-fed, burrowed down into the loose sand, where they

pupated. The pupae were small and many of them failed to develop into flies. The flies that did emerge were small, ill-nourished specimens.

It was noticed that in casual deposits on hard ground, such as is found in low-lying depressions in the desert known as "sabkit," maggots did not develop. The hard surface and rapid desiccation of the faeces inhibited development.

Incineration of excreta.—Box-seater latrines with self-closing lids covering buckets are used. Tibbin or sawdust is kept at each latrine and each man adds a handful to the bucket after use. This absorbs the moisture and facilitates incineration. In most cases, urinals are provided at the latrines, and troops are requested to use the urinal before using the latrine.

The contents of the buckets are burned in incinerators of the Horsfall type or other patterns. Fuel is generally needed to ensure thorough incineration and dry camp refuse is useful for the purpose. In a few cases the latrine seats are so constructed that the urine and faeces are separated, which facilitates the burning of the excreta. The incineration of night-soil requires most careful supervision, if it is to be carried out efficiently.

Several companies of the Camel Transport Corps came under my supervision for sanitation and the following method of dealing with the excrement of the native

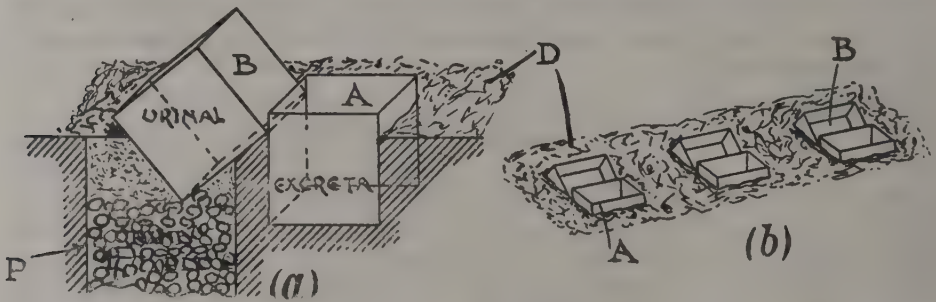


Fig. 2. Showing native latrine system for incineration of faeces—(a) side view section (b) plan: (A) Ration biscuit tin for faeces; (B) biscuit tin for urine; (P) urine pit; (D) surface of ground.

personnel, under mobile desert conditions, gave good results. Ration biscuit tins (fig. 2, A) (about 10 inches cube) were placed in a row about three feet apart, being let into the sand about three-quarters of their depth. In front of each tin, another tin (B) was placed, also let into the sand, but with its open top inclined at an angle towards the former tin and set close to it. The bottoms of the tins (B) were pierced with holes and beneath them a soakage pit (P), filled with old burnt tins, was first made, so that the tins (B) drained into it.

The natives squatted astride the tins (A) into which they defaecated, urinating at the same time into the tins (B). Each tin (A) was covered with a weighted piece of canvas soaked in kerosene or crude tar oil, which was replaced after use. One native was always on duty at the latrine as policeman.

The contents of the tins were incinerated in an incinerator made of biscuit tins filled with sand, with wire bands from tibbin bales forming the fire-bars. Camel dung was used as fuel to facilitate the incineration.

Portable latrine seats.—Under the mobile conditions necessary for troops in a desert campaign, the difficulties of obtaining materials are necessarily very great. Where camels are the only means of transport, every ounce of additional weight is a consideration, and the bulky sanitary stores which one may use in a standing camp are utterly out of the question.

The northern part of the Sinai desert, from the Suez Canal almost to the Palestine frontier, consists of very soft, rolling sand, with here and there a few palm groves, or "hods" and extensive sand dunes. It is impossible to use a shallow trench system of latrines, as winds and sand-storms would continually expose the excreta to flies. Further, owing to the loose nature of the sand, it is most difficult to localise the latrine area so that it can be satisfactorily treated afterwards to prevent fly-breeding. The number of flies produced from shallow trenches, as indicated above, is enormous.

In the Division to which my unit was attached during the advance across Sinai, a portable latrine seat designed by one of my N.C.O.'s was used and proved very serviceable (fig. 3).

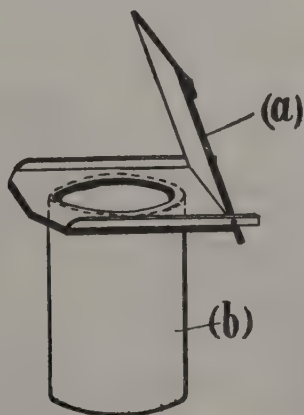


Fig. 3. A portable latrine: *a*, self-closing lid; *b*, cresol drum.

It consists of a light seat with a self-closing lid which fits tightly on a cresol drum. These lids were so made that they packed flat, and it was necessary to have a seat as light as possible compatible with strength. I am reminded that during the trial stage of these portable seats, one pattern which my N.C.O. made was most pleasing on account of its lightness and neatness. During its probationary career, however, it collapsed, much to the inconvenience of the person using it.

A special camel for carrying sanitary stores was allotted to each unit. Each camel could be loaded with about 16 to 18 portable latrine seats, together with the necessary drums, a portable incinerator, and a small quantity of disinfectant. This portable latrine proved invaluable for small scattered detachments in outpost lines, etc.

The contents of the drums were emptied into a deep, revetted pit, which was kept covered with canvas soaked in kerosene or crude tar oil. As the drums were emptied

into the pit, the excreta were covered with a few inches of sand. When the contents of the pit reached to about 2 feet from the top, it was filled in and treated as described in the case of deep trench latrines.

III. Disposal of Urine.

Several types of improvised urinals are used, being made from biscuit tins, cresol drums, or pieces of corrugated iron, and so constructed that the least possible fouled surface is exposed to flies. The urine is directed into the ordinary type of soakage pit, which is filled with perforated tins and completely covered in. Urine tubes which resemble somewhat a piece of stove piping, slightly tapering towards one end, are used considerably.

IV. Disposal of Camp and Cook-house Refuse.

The burial of unburnt cook-house refuse affords one of the gravest sources of fly-breeding in a desert campaign. The writer examined, nine days afterwards, holes in which unburnt refuse was buried with a covering of about one foot of sand, and found enormous numbers of pupae present and a few newly hatched flies already emerging through the sand. After the battle of Romani, in August 1916, we camped on an area of ground which had been used for a few days by mobile troops. In

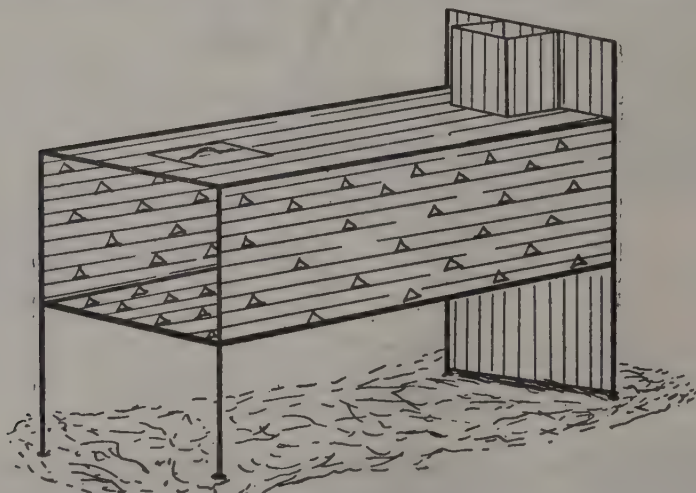


Fig. 4. Portable incinerator made with galvanised iron and iron pickets; holes are cut in the iron and top cover for drying the refuse.

certain places many newly emerged flies were found walking over the sand, and on digging in the sand at these places where obviously in some cases shallow latrines had been, and in others unburnt refuse had been buried, the pupae were so numerous that it almost looked as though a sack of large black oats had been buried there.

Under certain circumstances, when the front line troops were under observation by the enemy, it was not wise to incinerate, owing to the large volume of smoke produced. In these cases the cook-house refuse, which was kept covered from flies as much as possible, was buried in deep pits. The refuse was thoroughly treated with crude tar oil or cresol and the pits carefully filled in.

Units of the Mobile Desert Force carried portable incinerators of a type designed by Major Lelean, R.A.M.C., on the sanitary camel. These were very useful for small units and detachments. Brick or stone incinerators were built when possible, and burnt refuse was either buried in pits near the incinerators or removed to a dump on the outskirts of the camp.

A very efficient portable incinerator for use in the field was designed by one of my N.C.O.'s. It was made with sheets of corrugated iron (fig. 4), and this type was much used by units of the Division.

An incinerator is readily made with ration biscuit tins filled with sand forming the walls, and iron bands from tibbin bales as fire-bars. These materials were available in plenty from units of the Camel Transport Corps.

The incinerated refuse was buried in pits near the incinerator, all burnt tins, etc., being kept for making soakage pits. It is very necessary to ensure that the refuse is thoroughly burnt before being put into the pit. I have often found flies breeding in these pits owing to the presence of unburnt refuse. Before filling them in, they should be liberally treated with crude tar oil, or sprayed with 5 per cent. cresol solution.

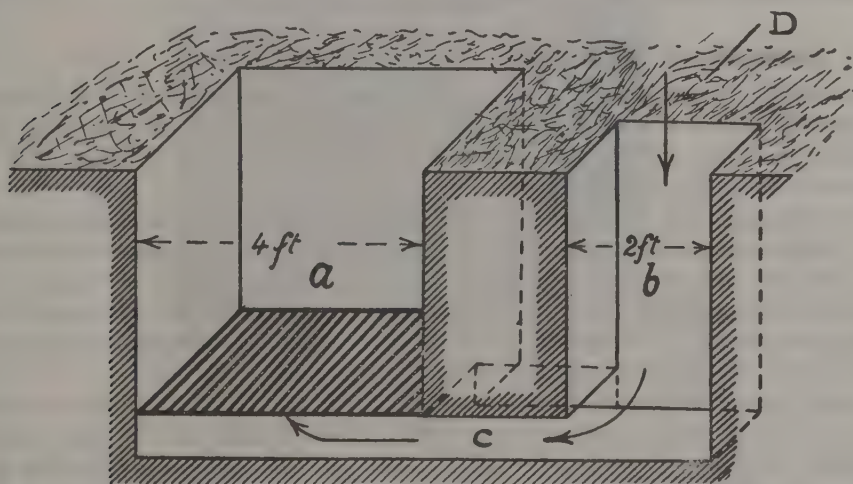


Fig. 5. Earth incinerator in side view section: *a*, fire pit; *b*, draught chamber leading through underground channel (*c*) to fire pit; (*D*) surface of ground.

The following type of incinerator (fig. 5), which is suitable where the ground is hard, was used on a "sabkit" near El Arish. It is very easily made and, for a short stay, is quite satisfactory, very little material being required. It consists of two square pits connected by a channel under ground. A piece of corrugated iron (or fire-bars) is placed at the bottom of the larger pit (*a*), which is made about 4 ft. cube and in which the fire is started, refuse and manure being then added. The smaller pit (*b*), which is about 2 ft. square, forms a draught shaft which fans the fire through the connecting channel (*c*).

Sanitary conveniences and incinerators were always erected at Railheads, Supply Depots, or other public places, and these areas were scavenged daily by native labour.

In this way these public areas, which are liable to be neglected, were kept clean, and possibilities of fly-breeding reduced to a minimum.

V. Disposal of Dead Animals.

Blue-bottle flies were only occasionally met with in any numbers on the desert, largely owing to the care taken in disposing of dead animals and the incineration of all used bully-beef tins, etc.

Dead camels, horses, and mules were dealt with as follows:—At the selected burial ground a large pit about 6 feet deep was dug, into which was put some old sacking, tibbin, firewood, etc., saturated with oil. Two or three stout iron bars were placed across the pit. The carcase was disembowelled, the cavity being filled with tibbin or old sacking saturated with oil. The legs were cut off and the prepared carcase placed over the pit on the iron rails. Oil was then poured over it and the whole set on fire. Gradually the remains of the carcase falls into the pit and when the fire is spent it is filled in.

A definite burial ground is established at every large camp, to which all dead animals must be taken and disposed of as described above.

VI. Destruction of Adult Flies.

In addition to the treatment of breeding places, the destruction of adult flies was vigorously carried out by means of the following methods:—(1) By spraying with various solutions; (2) by wire coated with tanglefoot; (3) by fly-traps; (4) by poisoned bait; (5) by fly flappers.

(1). *Spraying with solutions.*—Flies congregate in mess huts, mess tents, canteens and cook-houses, being attracted by the food and shade. These places were closed up and the flies sprayed with Lefroy's fluid (pyrethrum basis), or Osbeer's fly solution (Flybane), by means of a fine atomised spray, until the atmosphere was almost saturated. The flies fell to the ground dazed and helpless and were readily destroyed. Blockhouses were also treated in this way.

Often during the Khamseen winds, flies collect in great numbers on the lee side of canvas latrine screens, rush matting walls of cook-houses, etc. A soap-paraffin emulsion or a strong solution of cresol (about 10 per cent.) sprayed very forcibly and quickly on them with a Mackenzie sprayer was useful. They fell to the ground and were easily killed.

(2). *Tanglefoot fly wires.*—Tanglefoot was made by heating commercial castor oil almost to boiling (not boiling), and stirring in powdered resin until the mixture became a black sticky mass. The proportions used were: castor oil, 4 pints; resin, 9½ lb. It was found necessary to alter the proportion of resin slightly according to the time of the year. During the cold nights of the later part of the year, if too great a proportion of resin is used, it tends to crystallise out on the wires and the tanglefoot loses its tackiness. Pieces of wire were cut into lengths of 18–24 inches, coated with tanglefoot (applied when hot and the wires slightly heated), and hung up in tents, cook-houses, etc. Flies delight to rest on pieces of hanging wire or string, and very great numbers were caught on these wires. During the day-time the wires should be hung low down in the tents and high up towards evening. Flies always go to the top

parts of the tents to spend the night and will invariably select the wires to settle on. Often the wires are thickly covered with flies after hanging for an hour or so, and counts made showed that 200–250 were caught on an average on each wire.

The fly-wires are afterwards burnt clean and re-coated with tanglefoot. They were made in hundreds and issued to units who returned them to be re-coated.

Fly-papers were also issued by the A.S.C., but they are not nearly so efficient as tanglefoot wires.

(3). *Fly-traps*.—Several kinds of fly-traps are in use in the different camps. Successful baiting and the selection of a position for the trap where the flies are not disturbed are two important points. It is a good plan to change the variety of the bait and the position of the trap from time to time. A mixture of vinegar, bread and sugar is an excellent bait.

The following type of fly-cage (fig. 6) which I had made, being based on the American pattern of balloon fly-trap, gave excellent results.

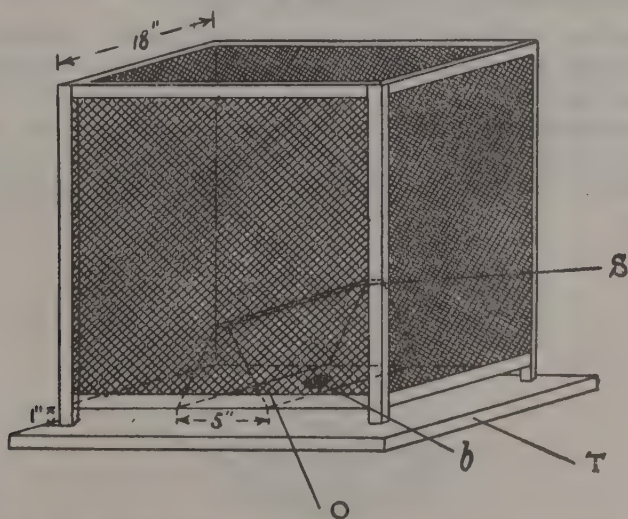


Fig. 6. Fly cage made with wire gauze on a wooden framework : o, opening on floor of cage ; s, narrow opening leading into the cage between the two inclined pieces of wire gauze ; T, wooden tray ; b, bait.

It consists of a box with wooden frame-work forming a cubical cage of 18 inches a side. The sides are of wire gauze, and the top is covered with mosquito netting. The bottom is made of light wood, the central portion (o), 5 inches wide, being left open, forming an opening 18 inches $\times$ 5 inches. Along the sides of this opening two pieces of wire gauze (18 inches $\times$ 7 inches) are fixed, inclined inwards and approximating, but just leaving sufficient space (s) for flies to get through into the cage.

The cage, standing on legs one inch high, is placed on a wooden tray (T). The part of the tray immediately below the opening (o) is painted black, and the bait is placed on this in the position (b). The flies, attracted by the bait, get into the angle between the two inclined pieces of wire gauze and make their way upwards towards

the light through the narrow slit (s) into the cage. It is necessary to have the slit only just wide enough for flies to get through. The writer remembers the afternoon this specimen trap was made. It was eagerly set with an attractive bait of vinegar, sugar and bread, and after three hours an enormous number of flies were imprisoned. They dashed about hither and thither in the cage, making a frantic buzzing noise. In the evening the cage was put into my bell-tent and after sundown the flies quietened down, although they were actively crawling about the walls of the cage. During the night I was awakened by something crawling over my face and on lighting the candle, was disgusted to find the roof of my tent literally black with flies. About 75 per cent. of my prisoners had escaped, owing to the too generous width of the slit (s).

The flies in the cage can be destroyed by fumigation with pyrethrum powder, or cresol heated on a tin. The smell which remains about the cage after fumigation tends to keep the flies away, so they were allowed to pass from the cage into a bag made with mosquito netting, and were then fumigated.

(4). *Poisoned bait*.—The use of the poisoned bait method was carried out with success under mobile desert conditions. Formalin (3 per cent. solution) sweetened with sugar was used in mess-tents, but sodium arsenite (Na_2HAsO_3) was used in the form of poisoned bait. Pieces of old sacking were soaked in a mixture of 1 per cent. solution of sodium arsenite in water containing 20 per cent. of ghur, and 12 per cent. of glycerine, rolled into a ball and hung near latrines. The glycerine prevented rapid drying.

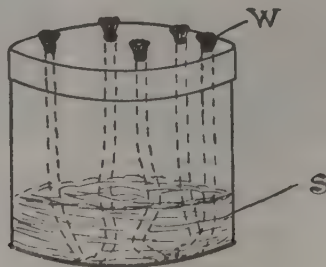


Fig. 7. Tobacco tin containing poison solution (s), with wicks (w) made of teased tent-rope passing through the lid.

As previously described, sodium arsenite was used at the manure dumps. Owing to rapid evaporation spraying on exposed surfaces was found not to be satisfactory.

The sodium arsenite-ghur poisoned bait, devised originally by Dr. Berlese and used with success in Mesopotamia by Professor Lefroy, gave excellent results. A sweet syrupy mixture was made containing 1 per cent. sodium arsenite, ghur and glycerine. This was put into cigarette tins or other available shallow tins. The lid of the tin was pierced with a number of holes, through which pieces of teased tent rope were drawn, forming a number of wicks (fig. 7). When the lid was replaced, these dipped into the mixture in the tin and sucked it up, so that the rose-like top

of the wicks on the outside of the lid was always moist with the poison. The flies eagerly gorged on these and died in shoals round the tin. By this method evaporation was reduced to a minimum.

Owing to the fierce heat of the sun the flies always seek shade. Small rush matting shelters were placed at convenient positions round the camp, on the shelves of which these tins of poisoned bait were put, and large numbers of flies, mostly of the house-fly type, were killed in this way. Occasionally *Sarcophaga*, *Lucilia* and *Calliphora* were found at the bait.

(5). *Fly flappers*.—Flies collect in large numbers during the heat of the day and towards the evening on the inside of the tents, and troops were encouraged to kill them.

Leather flappers pierced with holes, mounted on small wire handles, were issued for this purpose. Another and more efficient type, the flap of which is made with flexible wire gauze, is sold all over Egypt.

COLLECTIONS RECEIVED.

The following collections were received by the Imperial Bureau of Entomology between 1st July and 30th September, 1917, and the thanks of the Managing Committee are tendered to the contributors for their kind assistance :—

Dr. W. M. Aders, Economic Biologist to the Zanzibar Government :—About 12 Cyprinodont fishes (*Fundulus guentheri*, Pfeffer), foes of Mosquito larvae ; from Zanzibar.

Mr. W. K. Amyot :—1 Locust and 1 Dragonfly ; from Salonica.

Mr. T. J. Anderson, Government Entomologist : 1 tube of Coffee Bugs, 1 tube of Psyllidae, and 29 other Rhynchota ; from British East Africa.

Mr. R. S. Bagnall :—17 Hymenopterous parasites from Cecidomyiid galls ; from Northumberland.

Mr. G. E. Bodkin, Government Economic Biologist :—15 Hymenoptera, 10 Coleoptera, 2 Lepidoptera, 3 Rhynchota, and 2 Orthoptera ; from British Guiana.

Capt. G. D. H. Carpenter : 5 *Haematopoda*, 515 Coleoptera, 16 Hymenoptera, 11 Rhynchota, and 2 Earwigs ; from German East Africa.

The Division of Entomology, Pretoria :—12 Diptera, 26 Lepidoptera, 10 Hymenoptera, 53 Coleoptera, 1 Ant-lion, 46 Rhynchota, 36 Orthoptera, and 2 Odonata ; from South Africa.

The Government Entomologist, Madras :—42 Weevils ; from South India.

Mr. C. C. Gowdey, Government Entomologist :—10 Diptera, 3 Lepidoptera, about 70 parasitic Hymenoptera, about 300 Aphids, 17 other Rhynchota, 7 Orthoptera, 76 Ticks, and 8 tubes of Worms ; from Uganda.

The Imperial Institute :—About 50 Coleoptera, 5 Orthoptera, and about 50 Mites, from Cyprus ; and 10 Coleoptera, from Sumatra.

Mrs. A. Macdonald :—5 *Anopheles* Mosquitos ; from Suffolk.

Capt. A. Macdonald, R.A.M.C. :—112 Culicidae ; from Belfast.

Mr. A. Macdonald, Jnr. :—3 Culicidae ; from Dunfermline.

Mr. A. H. Ritchie, Government Entomologist :—54 Coleoptera, 2 packages of Coccidae, and 97 other Rhynchota ; from Jamaica.

Prof. F. Silvestri :—25 Bruchid Beetles ; from beans imported from Brazil.

D. C. Strickland :—28 Anopheline Mosquitos ; from the Federated Malay States.

Mr. F. W. Urich, Government Entomologist :—60 Coleoptera ; from Trinidad.

Lieut. Jas Waterston, R.A.M.C. :—4 Tabanidae, 36 other Diptera, 23 Hymenoptera, 33 Lepidoptera, 55 Coleoptera, 4 Planipennia, 3 Rhynchota, 8 Orthoptera, and 16 Odonata ; from Macedonia.

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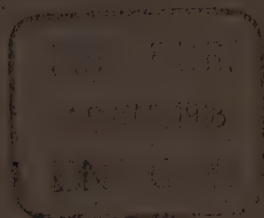
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